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# INSTRUCTION BOOK ON SERVICING OF THE PSBN – M RADAR BOMB SIGHT

(English Language)



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50X1-HUM

Instruction Book on Servicing of the
PSBN-M Radar Bomb Sight
Prague 1958
168 mimeographed pages in English

# INSTRUCTION BOOK ON SERVICING OF THE PSBN-M RADAR BOMB SIGHT

CHAPTER I.

SWITCHING AND PERFORMANCE CHECKING OF THE PSBN-M RADAR BOMB SIGHT.

§ 1. Switching of the Equipment.

Before switching on the radar bomb sight, the following measures must be taken:

a) Check of the correct and reliable connection of cables to individual units ( the number on the cable connector must correspond with that on the terminal of the respective unit);
b) The external appearence of the units is to be inspected as to absence of damages.

In the aircraft installed equipment is inspected, use a 27 V power -source of minimum 3 kW power for both the PSBN-M radar bomb sight and the MA-1500 K power convertor ( for example the truck-installed generators of the APA-2, APA-7 or ST-182 types). The radar bomb sight must never be supplied from the air-field accumulators or ground starting-cart. Also the supply of the radar bomb sight from the motor-driven airborne generators is prohibited during the operation of the aircraft engines on the airfield.

The equipment is turned on in the following sequence:

1) Set all controls of the radar bomb sight in the initial positions according to Table I.

T A B L E 1.

Positions of controls of the PSBN-M radar bomb sight equipment previous to switching

| Unit | Description of the control | Initial position of the control |
|---|---|---|
| Control panel of the power convertor (Unit No.21 M). Timer and control unit (Unit No.1c) | "Power convertor On-Off" switch | Off |
| | "Mains voltage regulation" control | Extreme left position |
| | "Power mains 27 V-115V" switch | "Off" |

| | | |
|---|---|---|
| | "Transmitter heating" switch | "Off" |
| | "Transmitter high voltage" push-button switch | Center |
| | "Beacon-Scanning" switch | Scanning |
| | "Time gain control" knob | Extreme left |
| | "Tube switch" | "1" |
| | "Calibration marking" switch | "10km" |
| | "Manual-Automatic" switch | " Manual" |
| | "Antenna control" switches: | |
| | a) "On-Off" | "Off" |
| | b) "Slow-fast" | "Slow" |
| | "Rectifier current-Magnetron current" switch | "Magnetron current" |
| | "Detector current-Power supply check" | "Power-supply check" |
| | "Range in km" switch | "10-60" |
| | "Expanded scope 10-60" control | Extreme right |
| | "R.F.gain" control knob | Extreme left |
| Computing mechanism (Unit No.8) | "Expansion of the center in km" | "0" |
| | "Range" control knob | Extrreme right "0" (according to the nomogram) |
| Plan-position indicator (Unit No.7) | "Brightness" control knob | Extreme left |
| | "Focus" control knob | center |
| Sector scanning control panel (Unit No.12) | "Sector-scan-Continuous rotation" switch | "Continuous rotation" |
| Azimuth stabilization Unit (Unit No.5) | "Compass-Selsyn zero-Optical bomb sight" switch | "Selsyn zero" |

| | | |
|---|---|---|
| Control panel on the PPI unit (Unit No.36) | "R.f. gain" control knob | Extreme left |
| Potentiometer control panel | "Expanded scope 10-60" control knob | Extreme left |
| | "Zero range-Calibration-Operation" switch | "Operation" |

2) Connect the aircraft electrical network to the airfield D.C. power mains.

3) Set the "Power convertor On- Off" switch ( on the power convertor control panel) to the position "On".

4) Set the"power mains 27V-115V" switch of the timer and control unit to the position "On" and after one minute turn on the "Transmitter heating" switch. The pointer of the "Voltage control" meter should deflect to 115 V, i.e. to the middle of the red sector on the scale of the meter. If necessary, the voltage may be regulated by means of the "Mains voltage regulation" control knob.
Be sure that the "Voltage control" meter indication installed in the timer and control unit corresponds to that of the A,C. voltmeter, installed in the receptacles of the control panel of the power convertor. Should both indicated voltages differ from each other, the power convertor voltage has to be regulated by means of the A.C. voltmeter.

5) By means of the "Brightness" and "Focus" control knobs on the plan position indicator the respective values of brightness and focus of the PPI screen should be regulated.

6) Five minutes after the switching in of the transmitter heating the "Transmitter high voltage" push-button switch has to be pressed and again released. According to the kind of operation the other switches and controls should be set to their respective positions immediately after the transmitter heating is switched in. The radar bomb sight equipment is disconnected in the reversed sequence, i.e. first the "Transmitter heating" switch is opened, then the "Power mains 27V-115V" switch and finally the "Power-Convertor On-Off" switch. The high voltage of the transmitter is disconnected by the "Transmitter heating" switch. After the equipment is switched off, all controls should be set back to their respective initial positions according to Table I-.

§ 2. Check of the operation of the rader bomb sight aboard the Il.-28 aircraft.

1) Connect the aircraft electrical system to the airfiels power mains ( for example AIIA-2, AIIA-7, OT-182).
2) On the electrical instrument panel of the navigator post connect the automatic protection (AZS) "Voltmeter". The "Accumulator switch" to be set to the position "Off". Set the D.C. voltmeter switch to the position "mains network" and the "Radiocompass-Rader" switch of the A.C. voltmeter to the position "Rader".
3) Be sure that the voltmeter in the electrical instrument panel at the navigator's post indicates the voltage of 27 V in the aircraft power-mains network.
4) Switch in the automatic protection AZS "Wave-guide pump". On the control panel of the air pump the "Heating" signalling lamp has to light up, and the heating system of the air pump is turned on. This system is used also for heating of the horizontal and vertical rotation joints connecting the feeder with the antenna. At the ambient air temperature below -10°C, the heating system ( AZS "Waveguide pump") must be put into operation 10-15 minutes previous to switching in of the other units of the PSBN-M equipment,
5) Put in the operation the MA-150OK power-convertor by means of turning the "power-conventor On-Off" switch to position "On". The A.C. voltmeter (EV-46) installed on the electrical instrument panel of the navigator's post must indicate a voltage of approximately 115-120 V.
6) Set the "Power mains 27V-115V" switch to position "On".
7) After 30 to 60 seconds the "Transmitter heating" switch should be set to position "On". On the scale of the "Voltage control" meter installed in the timer and control unit check the A.C. voltage of 115 V (within the limits of the red sector on the meter scale). By turning the "Mains voltage regulation" control knob on the power-convertor control panel the same indication should be obtained on the scale of the control meter on the timer and control unit and on the A.C. voltmeter (EV-46 on the electrical instrument panel at the navigator's post.

8) Bring the antenna into rotation by switching in the "control On-Off" switch to the position "On".
9) By means of the "Brightness" and "Focus" control knobs on the front panel of the plan position indicator the sweep trace on the screen of the PPI tube should be adjusted in such a way that a narrow and well visible trace is obtained.
10) Be sure that the beginning of the sweep is in the centre of both the screens of the PPI tube and the cursor on the light filter. Should not be the beginning of the sweep in the correct position, the axles of the "PPI horizontal and vertical centering" should be adjusted to place the beginning of the sweep to the cursor of the light-filter ( the axles of the potentiometers are accessible from the front panel of the timer and control unit). During the centering the screen of the CRT has to be observed in such a way that the mirror image of the operator's eye on the light filter glass reflects exactly in the center of the cursor of the light filter installed on the screen of the plan position indicator.
11) Press the "Up-down" push button switch placed on the control panel, and check ( by means of the antenna-tilt indicator on the timer panel) the antenna-tilt angle change.
12) Turn the "Slow-Fast" switch to the position "Fast" and check ( from the increased speed of rotation of the sweep line on the screen of the plan position indicator) the change in antenna rotation speed.
13) Turn the "Sector scan-Continuous rotation " switch to position "Sector scan" and check the sector sweep of the antenna in the respective sectors with various positions of the sector switch on the sector control panel.
14) Place the "Sector scan-Continuous rotation" switch to the position "Continuous rotation" and the "Slow-Fast" switch to the position "Slow".
15) Check the manual control of the antenna rotation by pressing the "Right-Left" switch on the timer and control unit. The sweep on the screen of the plan position indicator CRT must rotate in the corresponding direction.
16) From the display on the monitoring CRT of the timer and control unit and the CRT of the plan position indicator check the presence of the calibration markers on the respective CRT screens.

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for this set successively the "Calibration marking" switch to the positions "2 km", "10 km" and "20 km". The calibration markers will be presented as pips on the monitoring CRT and in form of bright spots on the sweep of the plan position indicator CRT. With a rotating antenna they take a form of circles. Be sure that no vibration of the calibration markers is visible.

17) Set the "Calibration marking" switch to the position "BM". In this position, two pulses must be presented on the CRT screens, viz. the measuring pulse and the pulse of the transversal marker. In the position "Off" only one measuring pulse is visible.

18) Check the performance of the range measurement channel by turning the "Range" control knob of the computing mechanism. The measuring pulse must move along the sweep on both CRT screens.

19) Turn the "Tube switch" to the position No. "4", and check the frequency division 1:5 in the range unit.
On the screen of the monitoring CRT four small two-kilometer markers must be visible between the two neighbouring greater ten-kilometer markers, if the performance of the frequency division circuits is correct. Should more or less than four of the small markers be visible, the ratio of 1:5 of the frequency division must be adjusted by turning the axle of the R408 potentiometer "1:5 division adjustment"; the axle is accessible from the righthand side panel of the marker and control unit.
Turn the "Tube swicth" to the position "1".

20) Turn on the antenna rotation system and inspect the scales of range display in the following way:

a) turn the "Calibrator marking" switch to the position "10 km" and the "Range in km" switch to the position "100". Exactly ten ten-kilometer sections separated by calibration circle markers should be presented on the screen of the plan position indicator. If the range differs from that of 100 km, the axle of the "Sweep control" potentiometer ( accessible from the timer and control unit front panel) must be turned to adjust the exact 100 km range.
Should the sweep be too short or should it surpass the screen of the plan position indicator, the axle of the "Sweep amplitude" potentiometer must be turned to obtain a sweep corresponding to the radius of the PPI screen. This axle is ac-

cessible from the front panel of the timer and control unit.

b) Turn the "calibration marking" switch to the positi50X1-HUMd the "Range in km" switch to the position "200"; from the calibration circle markers find the length of the sweep length which should be between 190 and 210 km.

c) Set the "Range in km" switch to the position "10-60" and turn the "Expanded scope 10-60" control on the control panel to its extreme position in anti-clockwise direction. Set the "Calibration marking" switch to the position "2 km". Shift the next calibration circle marker to the beginning of the sweep and check by the 2 km markers the range indicated by the sweep which should be from 7 to 9 km.

d) Turn the "Expanded scope 10-60" control knob clockwise to its extreme position and set the "Calibration marking" switch to the position "10 km". Correct the sweep scale according to calibration markers (55-65 km).

21) Set the "Detector current- Power supply check" to the position "Detector current". By turning the "Receiver tuning" control knob the maximum magnitude of the detector current should be checked; it should be from 0,4 to 0,9 ma.

22) Turn the "R.f. gain" control in clockwise direction to its extreme position; in this position the noise ( "grass") will be observed on the screen of the monitoring CRT. The brightness of the sweep trace on the screen of the plan position indicator tube will also increase. By turning the shaft of the "Calibration marking" potentiometer the standard brightness of the calibration markers should be adjusted now to be distinctly noticeable on the background of the noise.

23) Be sure of the presence of the course marker on the screen of the plan position indicator tube; this marker should point in the zero direction of the azimuth scale. When necessary the brightness of the course marker can be adjusted by means of the "Course mark brightness" potentiometer.

24) Check the correct performance of the system of azimuth stabilisation by setting the switch placed on the azimuth stabilization unit to position "Compass". The course mark should change its position and indicate the compass course of the aircraft. Set the switch on the azimuth stabilization unit to position "Selsyn-zero". The course marker should change against its posi-

tion to "Zero" on the azimuth scale of the plan positi[illegible]tor.

Four or five minutes after having turned on the "Transmitter heating" switch the "Transmitter high voltage" push-button switch should be pressed and released,

On the screen of the monitor CRT a pulse should appear, and on the screen of the plan position indicator a bright spot should be visible at the beginning of the sweep.

) The magnitude of the average current of the magnetron has to be checked now by a meter situated on the panel of the timer and control unit; the respective switch should be set to position " Magnetron current". The current measured should be 6 to 8 ma in position "10-60" of the "Range in km" switch, and 10 ma in position "100" of the same switch.

) Set the "Rectifier current-Magnetron current" to position "Rectifier current" and measure the current of the rectifier. This current must not surpass the proper magnetron current by more than 5 ma.

Should the "Magnetron current" meter indicate no current at all, or should the measured current differ considerably from the above mentioned values the high voltage of the transmitter must be turned off immediately. The same must be done if the pointer of the meter oscillates often and abruptly or if the current of the rectifier considerably exceeds that of the magnetron. The high voltage is immediately switched off by means of the "Transmitter heating" switch, and shortly afterwards this switch should be turned on again. If the transmitter performance is still inadequate, the whole equipment must be inspected and repaired if necessary.

8) The operation of the system of continuous sweep delay has to be inspected on the "60 km" scale. This is done by means of turning the "Center expansion" control knob installed on the panel of the computting mechanism unit. When turning the "Expansion of the center in km" control knob in clockwise direction to its extreme position "-20 km" the pulse of the transmitter ( the bright circle) should move from the beginning of the sweep on the screen of the plan position indicator CRT towards the center of the sweep by at least 15 km.

When turning the "Center expansion in km" control knob to its extreme position in anti-clockwise direction (i.e. +40 km), further four te-kilometer circular range markers should follow the transmitter pulse marked into the center of the CRT screen.

9) The 10-15 km sweep ratio has to be adjusted by means of the "Expanded scope 10-60" control knob. The "Center expansion in km" control knob has to be adjusted to such position in which the transmitter pulse marker has the form of a small circle close to the beginning of the sweep.

0) Cut off the antenna rotation and turn it towards the targets. Adjust the antenna tilt angle to $0^{0}$.

1) Turn the"receiver tuning" control knob, until reflected signals are presented on the monitor CRT in form of stable pips surpassing the level of the noise. On the screen of the plan position indicator CRT the display has a form of bright spots on the sweep trace. If no reflected signals are presented, the maximum detector current should be adjusted and the "Receiver tuning" control should be turned in anti-clockwise direction until the pointer of the meter indicates a current decreased by 0.1=0,2 ma from the maximum current value. Then the "Left-Right" push-button switch should be pressed until a weak display of the reflected signals could be visible on the CRT screen. By means of the "Receiver tuning" control knob and the antenna tilt control knob the maximum amplitude of the pips on the screen of the monitoring CRT ( or the maximum brightness of the reflected signals display on the PPI screen) should be adjusted.

2) Preliminary altitude tuning of the klystron is to be inspected now. This is done by turning the "Receiver tuning" control knob in clockwise direction until the maximum amplitude of the reflected signals is obtained. The indication of the pointer of the detector current meter should be noticed. The "Receiver tuning" control knob should be further turned in clockwise direction until the pointer of the detector current meter indicates maximum of the current.

The preliminary altitude tuning is correctly performed if with turning the "receiver tuning" control in clockwise direction the appearance of the maximum reflected signal on the CRT screen precedes the maximum indication of the detector current meter. The magnitude of the detector current, corresponding to the maximum amplitude of the reflected signals, should be some 75-85 % of the maximum value of the detector current.

33) Check the operation range of the "Time gain" control. For this it is necessary to adjust the sweep range of 40-60 km and to

turn the "Time gain" control knob in clockwise direction to the extreme position. During this adjustment the indication of the noise on the screen of the monitoring CRT within the range from 15 to 20 km from the transmitter pulse display should be absent, and afterwards it should continuously increase. The reflected signals should be considerably weakened in the vicinity of the transmitter pulse display.

4) Inspect the performance of the automatic frequency control by means of turning the "Manual-automatic" swicth to position "Automatic". The display on the CRT screen display as well as the magnitude of the detector current must not be substantially changed. If the indication of the "Detector current" meter descreases and the display of the reflected signals on the CRT screens disappears, the "Time gain control" knob should be adjusted to obtain a reliable indication of the meter pointer and an adequate display on both screens.

35) Set the "Range in km" switch to position "100" and check the performance of the circuits of the step delay of the beginning of the sweep. For this the "Sweep delay x 10 km" switch should be successively adjusted in steps to all positions up to position "24". The step sweep delay is correctly adjusted if the range display is maintained in all positions and the x sweep is reliable. In position "24" the brightness of the sweep is decreased. At the same time the frequency division of 1:13 in the range unit is to be checked. In the 100 km scale the transmitter pulse on the last te-kilometer marker appears in position "16" of the "Sweep delay" switch. This pulse will move discontinuously in steps of 20 km towards the beginnong of the sweep. In the 200 km sweep ratio the transmitter pulse marker appears on the 20th ten-kilometer marker in position "6" of the "Sweep delay" control

36) Inspect the operation of the air pump. For this check the "Automatic protection" switch on the control panel of the air pump as well as the 45V "Waveguide pump supply" s itch are to be turn on. Doing this, the "Pump" signalling lamp situated on the control panel should light up. After one or two minutes the signalling lamp should go out as the pump is automatically turned off. The pressure-range installed in the antenna assembly of the aircraft and closed in the pump system should indicate

a pressure of 1 - 1,2 atm. The automatic operation of 50X1-HUM
should start again ( the signalling lamp "Pump" lights up) af -
ter a period of at least 15 minutes ( not before this time).

) Inspect the performance of the coupling unit of the optical bomb sight N.OPB-6 sr in the following order:

a) the sweep ratio "8km" should be adjusted and the antenna rotation mechanism turned on.

b) the switch on the azimuth stabilization unit should be set to position "Optical bomb sight" (OPB). On the screen of the monitor CRT a transverse mark should appear, placed in the middle of the sweep line and on the azimuth scale a longitudinal mark should be visible. Cut off the antenna rotation system.

c) Adjust the zero angle of sight on the optical bomb sight; also the delay introduction lever should be adjusted to zero level. Turn the optical bomb sight so that the drift angle on the scale of the course stabilization of the AIL-5 automatic pilot is zero. Note the position of the sweep trace which is to be considered as zero position ( the supply of the optical bomb sight should not be turned on during this checking).

d) turn the optical bomb sight by 15° from the 0° position on the drift angle in clockwise direction.
The plan position indicator sweep trace should move in anti-clockwise direction by an angle of 15° ± 0,5°.

e) Deflect the optical bomb sight by 15° from its 0° position in anti-clockwise direction. The sweep trace on the plan position indicator screen should deflect in clockwise direction by an angle of 15° ± 0,5°. From the zero position. Fix the optical bomb sight in the position corresponding to the zero drift angle.

f) Deflect the optical bomb sight by 15° on the drift angle scale in an arbitrary direction and write down the angle of the sweep deflection. Adjust the angle of sight of the optical bomb sight to 20.5° and introduce a delay of 200/1000 on the delay introduction scale. After this adjustment the sweep trace should be further deflected by an angle of 8° ± 0,5°.

g) Set the "Operation-Calibration" switch to position "Calibration". By this adjustment the two-kilometer markers should be visible on the both CRT screens. Check the calibration of the coupling unit of the optical bomb sight on the calibration markers, and, if necessary, adjust additionaly the unit ( according to instruction in § 3 of this chapter).



Note: Before checking the performance of the coupling unit of the OIIB-6cp, the optical bomb sight system has to be inspected and adjusted. During the inspection of the system the gyroscope of the optical sigt must be locked, and the optical bomb sight must not be energized.

8) Cut off the power supply of the radar bomb sight by turning off the switchnes in the following sequence: "Transmitter heating", "power mains 27V-115V" and "Power convertor On-Off". Set all the switchnes in their respective initial positions according to instruction given in Table 1. Cut off the power supply of the pump and set the "Waveguide pump" automatic protection switch "AZS" to position "Off".

The inspection of the performance of the radar bomb sight installed in other aircraft types is done in the same order, except Item 2 of this paragraph. The power mains network of the aircraft is to be connected in accordance with the circuit diagram of the respective type.

## § 3. Inspection and calibration of the coupling unit of the OPV-6sr airborne bomb sight

### A. Checking the position of the longitudinal and transverse mark.

1) Energize the radar bomb sight, and after some 15-20 minutes set the switch on the azimuth stabilization unit panel to the position "Optical bomb sight".
2) Set the "Range in km" switch to the position "10-60", the switch of the monitoring CRT to the position "1", and the "Sweep delay" switch to position "Zero". The "R,F. gain" control knob should be turned in anti-clockwise direction to its extreme position.
3) The scanning-sector switches on the control panel of the sector scanning unit should be set to their respective positions to obtain the front scanning sector of 60° angle. The "Sector scann- Continuous rotation" switch should be set to position "Sector

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scanning" and the antenna rotating system should be set to position "Fast". On the screen of the plan position indicator CRT a longitudinal marker should appear in the zero angle position of the azimuth scale. If this marker does not point towards the zero reference of the scale, four screws holding the deflection coil of the PPI tube have to be partly released, and the coil has to be slowly turned and installed in a position in which the longitudinal marker points exactly to the zero angle of the azimuth scale.

4) Turn the "Expanded scope 10-60" control knob on the respective control panel in anti-clockwise direction to its extreme position and check the position of the transverse marker which should be placed in the middle of the sweep panel within the limits of 1 km.

5) Check the position of the centre line of the front scanning sector in relation to the longitudinal marker. The centre line of the front scanning sector should coincide with this marker with an admissible tolerance not exceeding 5°. (The measurement is performed by means of the rotating cursor on the filter on the PPI tube; the dark sector of the screen is not taken in account in this measurement).

B. Calibration of the range channel of the coupling unit of the optical bomb sight.

1) Set the "Operation-Calibration" switch to the position "Calibration". In this position the two-kilometer markers must appear on the screen of the monitoring tube and of the plan position indicator tube.
2) Set the maximum sweep ratio. The angle of sight of the optical bomb sight should be adjusted to zero.
3) Switch in the transmitter by pressing the "Transmitter high voltage" push-button switch, and set the antenna system to fast scanning in the front sector.
4) By means of the "Altitude: handle of the optical bomb sight an altitude of ( 2-a) km is to be adjusted, where "a" is the constant error in the range measurement. The altitudes at which the calibration is to be done as well as the value of the con-

stant error in the range measurement are given in a table instrumental on the coupling unit of the optical bomb sight.

5) Turn the "Zero range adjustment" control knob to adjust the first two-kilometer circular marker on the PPI screen next to the transmitter pulse marker to coincide with the transverse marker. This coincidence is obtained by shifting the outside contour of the transverseal marker with the inside contour of the two-kilometer circular marker ( see Fig.1).

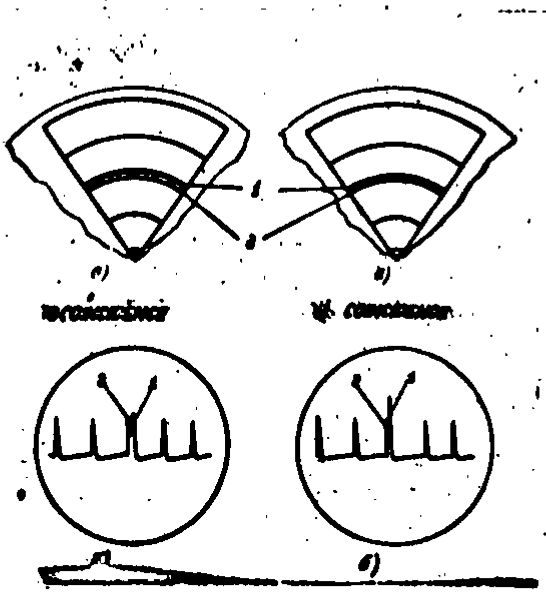

Fig.1. Display on the indicator screens with the calibration of the coupling unit of the optical bomb sight:
Upper part: Display on the PPI screen
Lower part: Display on the monitoring CRT screen
Left: Before coincidence of the two markers
Right: After coincidence of the two markers
1 -the two-kilometer marker
2 -the transverse marker

6) Adjust the altitude of ( 1-a/2) k. and the angle of sight of 60°. For this the first two-kilometer circular marked following the transmitter pulse display should coincide with the transverse marker. If the coincidence is not accurate, the axle of the "Range stabilization adjustment" potentiometer should be turned to obtain the necessary coincidence of the transverse marker with the first two-kilometer range marker. The calibration is to be checked in the position of H=2-a km, and =0°.

t the "altitude" control knob of the optical bomb sig
ition (10-a) km, and the angle of sight to = 0°. Now turn
he "maximum altitude adjustment" control knob to obtain the
oincidence of the fifth two-kilometer circular marker with the
ransverse marker.
djust the "Altitude" control knob of the optical bomb sight to
osition (10-a/2) km, and the angle of sight control knob to a
osition corresponding to an angle of 60°. By turning the "Ma-
imum range adjustment" control knob obtain the coincidence of
he transverse marker with the tenth two-kilometer circular mar-
er ( the tenth circle from the transmitter pulse display).
he checking is to be performed at the altitudes of (2-a) km
nd (10-a) km, and also at (10-a/2) km with an angle of sight
f 60°. If necessary, the calibration should be corrected.
heck the calibration once more at the altitudes of (2-a) km and
10-a) km with an angle of sight of 0°, as well as at ( 10-a/2)
km with an angle of sight of 60°.
If necessary, supplementary correction should be done according
to instructions in Items 5,6,7 and 8 of this paragraph.
The calibration is to be repeated until the transverse marker
coincides with the 1st, 5th and 10th two-kilometer circular mar-
kers at the above given altitudes and angles of sight ( with an
accuracy of ± 30 m).

Inspection and adjustment a the course channel in the coupling unit of the optical bomb sight.

Set the "Operation-Calibration" switch to the position "Operation" Cut on the antenna rotation system. Adjust the optical bomb sight to a position corresponding to the drift angle of 0°. The "Delay" control knob of the optical bomb sight set to zero. Now press the "Left-Right" push-button switch and adjust the sweep trace to the zero of the azimuth scale. The angle of sight of the optical bomb sight should be set to 75°.
Turn the optical bomb sight in clockwise direction by an angle of 15°. The sweep on the screen of the plan position indicator CRT should deflect by an angle of 15° ± 1° in anti-clockwise direction. Should be obtained deflection of the sweep trace exceed the limits of 15° ± 1°, the cover of the coupling unit of the optical bomb sight should be removed and the shaft of the R31 potentiometer has to be adjusted to shift the sweep trace

o the correct position. ( the potentiometer is installed on the chassis of the coupling unut of the optical bomb sight). Then the optical bomb sight should be turned by 30° in anti-clockwise direction and the position of the sweep trace should be checked. The sweep trace should be placed in a position corresponding to 15° ± 1° of the azimuth scale. If necessary, the sweep line can be adjusted to the correct position by means of the R05 potentiometer installed on the chassis of the coupling unit of the optical bomb sight. Now the optical bomb sight has to be turned again by 30° in clockwise direction and the angle of the deflection of the sweep trace should be checked. If necessary, the adjustment has to be performed by means of the R31 potentiometer. The adjustment by means of the R05 and R31 potentiometers should be repeated untill the sweep trace is placed in the respective correct position.

Now the accurancy of the course channel transmission of the angle of deflection of the optical bomb sight to the pan position indicator is to be inspected. For this reason the optical bomb sight has to be turned in two-degree steps from the zero angle to 10° and further in steps of 5 degrees to 30°.

The error in the deflection angle transmission through the course channel of the coupling unit of the optical bomb sight should be less than 0,5° with drift angles up to 10° and less than 1° with drift angles from 10° to 30°. Should the error in any of the inspected positions surpass the admissible magnitude, the compensation of the excessive error may be obtained by adjusting the R31 and R05 potentiometers. By this compensation additional increase of the error may take place in some other positions. However, the compensation is to be done in such a way that the error be within the admissible tolerances in all of the positions checked.

This inspection is to be done in both directions of the optical bomb sight, viz. in the clockwise as well as in the anti-clockwise direction.

After the course channel is adjusted, the initial zero position of the course channel has to be checked once more ( see par.4).

spection and adjustment of the transverse stabiliz[illegible]nel.

t the drift angle of the optical bomb sight to 0°. Also the lay introduction lever of the optical bomb sight has to be t to zero position.

y turning the angle of sight handle the angle of sight has to e changed from 0° to 70° and the sweep trace on the plan positin indicator CRT has to be checked as to the stability of its osition. If the stability is not sufficient, the position of the weep trace with the angle of sight of 70° is to be noted. Now he angle of sight of 20° is to be adjusted, and by turning the xle of the "Zero bank adjustment" potentiometer the sweep trace is to be set to the position in which it was noted with the angle of sight of 70°. Then the adjustment of the zero bank should be checked again and supplementary correction should be performed, if necessary. The above described adjustment is repeated untill the sweep trace on the screen of the plan position indicator is stable within the change of the angle of sight between 20° and 70°.

Turn the optical bomb sight in clockwise direction by an angle of 15 °; the sweep trace on the plan position indicator should move in anti-clockwise direction by the same angle. Now adjust the angle od sight of 20.5° and by means of the lever installed on the optical bomb sight introduce a delay of 200/1000. During this adjustment the sweep trace of the plan position indicator CRT should further turn by an angle of 8° ± 0,5° in anti-clockwise direction. If the deflection angle is greater or smaller than the above mentioned deflection, the angle has to be adjusted to 8° by turning the axle of the "Transverse stabilization adjustment" potentiometer.

Check the operation of the transverse stabilization channel while the optical bomb sight in anti-clockwise direction as described in Item 3.

4. Inspection and zero course adjustment of the servomechanism of the PSBN-M radar bomb sight (Adjustment of the radar bomb seight)

1) Check the position of the course marker of the radar bomb sight in reference to the longitudinal axis of the aircraft in the following way:

Two plummets should be hung from the checking points on the longitudinal axis of the aircraft, viz one from the nose of the aircraft and the other from its tail.

) Stretch a cord of 25-30 m lenght along the longitudinal axis of the aircraft so that a part of this cord of 10-15 m is placed in the front of the aircraft nose.

) Adjust the optical bomb sight in the zero drift angle position, and set the delay introduction lever to zero position.

) Turn the "angle of sight" handle of the optical bomb sight and check the shifting of the course mark in the visor of the optical bomb sight with respect to the stretched cord.

e) During the change of the angle of sight from $0^{\circ}$ to $70^{\circ}$ the course mark should move along the line of the stretched cord, or along a parallel line. The maximum admissible value of divergency of the course mark is 7 - 15 minutes; should it be greater, the optical bomb sight has to be re-adjusted.

Cut on the power supply of the redar bomb sight and check the position of the longitudinal mark as well as the operation of the course and transversal stabilization channels ( see instruction in par. 3, A,C,D,).

Install the corner reflector at a distance of 800 to 1200 meters in front of the aircraft at an angle of $5^{\circ}$ - $7^{\circ}$ to the left side of the longitudinal axis of the aircraft. The nose of the aircraft should be slightly elevated ( by an angle of $4^{\circ}$ -$5^{\circ}$).

Cover the side openings of the nacelle in the front strut of the aircraft.

Turn the optical bomb sight in the direction of the corner reflector. During this the gyroscope of the optical bomb sight must be locked, the delay must be zero, and the "Altitude" control knob must be set to its minimum altitude position.

) Set the lengthening control of the optical bomb sight and turn the angle of sight handle until the corner reflector appears in the field of vision of the optical bomb sight. If the frame of the cabin-window obstructs the sight, the nose of the aircraft must be elevated by installing a jack under the nose leg of the aircraft under-carriage,

7) Turn the optical bomb sight so that the corner reflector coincides with the course mark of the optical bomb sight. The drift

angle on the optical bomb sight should be 5° to 7° 50X1-HUM is adjustment. In orther case move the corner reflector in another position.

Cut on the fast-scanning mechanism of the antenna system in the front scanning sector ( the switch installed on the panel of the azimuth stabilization unit must be set to position "Optical bomb sight"). The "Expanded scope 10-60" control is now used to adjust the sweep ratio of 8-10 km-. The angle of sight on the optical bomb sight is to be adjusted to zero.

Cut on the transmitter high voltage and observe the screen of the plan position indicator CRT for the display of the reflection from the corner reflector. If this signal is difficult to distinguish from the other " targets", the corner reflector must be folded down ( or deflected in azimuth by 90°-160°) and then again installed in the position.

By observing the disappearance and restoration of the signal reflected from the corner reflector its position on the PPI screen may be easily distinguished from other reflections. During this checking the drift angle of the optical bomb sight should be the same as the angle adjusted according to Item 7 of this paragraph.

If the initial zero adjustment of the course channel is correct, the display of the corner reflector signal must be placed on the longitudinal marker. If this is not so, the following measures must be taken:

a) Take off the radome of the radar bomb sight antenna.

b) Loosen the four screws holding the oval cover in the back part of the azimuth differentiating system and take off the cover.

c) Loosen slightly the three screws holding the pressing ring of the R 1707 potentiometer of the optical bomb sight.
Turn the case of the R 1701 potentiometer until the display of the signal from the corner reflector is placed exactly on the longitudinal marker; the transverse marker should divide the display of the corner reflector signal on the screen of the plan position indicator CRT into two equal parts.
After this adjustment the indication on the calibrated gear-drive of the azimuth differentia-ting system should be written down with an accurancy of $\pm$ 0,25° to facilitate future adjustment after replacement of the optical bomb sight or its coupling unit without the necessity of application of the corner reflector with the adjustment of the radar bomb sight.

ighten the screws of the R 1701 potentiometer and replace the
ack cover of the azimuth differentiating system.
f the difference angle between the display of the corner reflector signal and the longitudinal marker is not greater than $6^{\circ}$ - $6^{\circ}$, the adjustment may be done by means of the course potentiometer installed in the front part of the optical bomb sight; the correction should be done in the following way:

a) Remove the five bolts holding the cover of the course potentiometer and remove the cover.
b) Remove the four screws fastening the lid of the regulation element of the course potentiometer to the cover and remove the lid.
c) Loosen partly the four screws holding the rotating mechanism of the course potentiometer.
d) Replace the cover of the course potentiometer and tighten it by means of two screws.
e) Adjust the control knob of the course potentiometer to obtain the coincidence of the display of the corner reflector signal with the longitudinal marker on the PPI screen.
f) Remove the cover of the course potentiometer, tighten the screws and replace the cover and the lid.

) Cut off the antenna rotation system.
) Adjust the optical bomb sight to a position corresponding to zero drift angle.
) Press the "Left-Right" push-button switch and adjust the sweep trace on the plan position indicator to zero of the azimuth scale ( in coincidence with the longitudinal marker). The direction of the maximum radiation of the radar bomb sight antenna now coincides with the longitudinal axis of the aircraft.
4) Set the switch on the azimuth stabilization unit to position "Selsyn zero". The sweep trace on the plan position indicator screen must stay in the azimuth zero. Should the sweep line deflect after the switch it set from "Optical bomb sight" to "Selsyn zero" position, the following measures must be taken:
   a) Loosen partly the screw holding the adjustment sector of the zero selsyn (" Zero adjustment").
   b) Turn the sector of the zero selsyn until the sweep line on the PPI screen points to the zero of the azimuth scale.
   c) Tighten the adjustment sector of the zero selsyn.

t on the antenna rotation system and check the posi
e course marker of the radar bomb sight which should point
the zero direction of the azimuth scale. If the course mar-
er is shifted to the left or right side of the zero azimuth ,
he cam of the miniature switch of the course marker, installed
n the base of the antenna gear-drive should be adjusted in
uch a way that the course marker points in the direction of
he zero on the azimuth scale.
ut off the power-supply of the radar bomb sight.

Inspection of the performance of the airborne PSBN-M radar bomb sight by means of the checking resonator type 50 I.

he checking resonator serves for evaluation of the performance
he r.f. circuits of the radar bomb sight and for determination
he operation frequency of the transmitter magnetron.
he inspection is done in the following order:
Install the checking resonator on its stand.
Insert the waveguide twist joint between the waveguide input of the checking resonator and the horn antenna from the 50I equipment.
Install the checking resonator at a distance of approximately 4 to 5 m from the antenna of the radar bomb sight to the left or right side of the aircraft ( the radome of the radar antenna need not be removed). Direct the horn antenna of the 50I instrument towards the radome of the radar antenna.
Set all controls of the radar bomb sight to their respective initial positions ( See.Table 1.).
Cut on the power-supply of the radar bomb sight as described in § 1, Items 4 and 5.
Set the "R.f. gain" control knob to its extreme right position, and turn the "Expanded scope 10-60" control knob in anti-clockwise direction to its extreme position. The "Expansion of the center" control knob on the computing mechanism unit set approximately to 0°.
Set the "Sector scanning- Continuous rotation" switch on the control panel of the sector scanning to position "Sector scanning" and cut on the antenna rotation system. The "Slow-Fast" switch on the timer and control unit set to position "Fast".

By means of the sector switches on the sector scanning panel the 60° sector scanning has to be adjusted so that the scanning radar antenna radiates its signals towards the horn antenna of the 501 checking resonator ( to be observed on the PPI screen).

Cut on the high voltage of the transmitter.

Turn the"Attenuator" control knob on the 501 instrument in anti-clockwise direction to its extreme position and slowly turn the "Tuning" control knob on the 501 instrument within the limits of 9 to 12 and 25 to 28 great divisions on the right scale of the wavelength-meter of the 501 resonator. The checking resonator is to be tuned so long untill the pointer of the microamperemeter on the panel of the 501 resonator starts swinging from zero towards higher current indications ( this swinging of the pointer of the checking resonator is caused by the scanning of the antenna).

11) Switch off the antenna rotation system. Set the "Detector current- power-supply check" switch to the position " Detector current"-. Turn the "Receiver tuning" control knob until the detector current meter indicates a value corresponding to the maximum amplitude of the reflected signals ( see. § 2, Items 31 and 32). Set the "Manual-Automatic" switch on the timer and control unit panel to position "Automatic".

12) Press the "Left-Right" push button switch of the antenna rotation control and turn the antenna system to obtain the maximum deflection of the pointer of the microampermeter on the 501 resonator. If at this moment the pulse of the checking resonator is presented on the monitoring and the plan position indicator screen, the antenna should be turned till the maximum width of the pulse of the checking resonator is obtained.

13) Slightly turn the "Tuning" control knob on the checking resonator panel and tune the instrument to the frequency of the transmitter magnetron ( maximum deflection of the pointer of the 501 microamperemeter).

14) By turning the direction handles of the resonator stand ( left-right and up-down), the maximum microamperemeter indication is to be obtaind.

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Turn the "Receiver-tuning" control on the timer and control unit panel to obtain the maximum width of the pulse of the checking resonator ( see Fig.2).

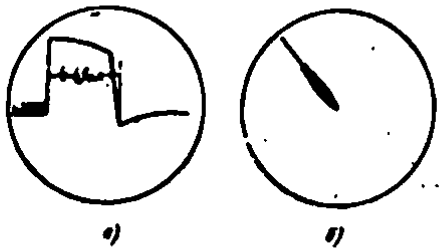

Fig.2 Display of the checking resonator pulse on the screens :
a) - The monitoring CRT
b) - the plan position indicator CRT

Turn the antenna right and left, as well as up and down, and repeat the position adjustment and the tuning of the checking resonator. Also the receiver of the radar bomb sight has to be tuned to obtain the maximum width of the checking resonator pulse both on the monitoring CRT ( Fig.2a) and on the plan position indicator CRT ( Fig.2b).

Turn the "Attenuator" control of the 501 resonator in clockwise direction till its extreme position. A slight increase of the width of the checking resonator pulse is obtained.

Turn the "Range" control knob on the panel of the computting mechanism unit to bring the measurement pulse display to coincide with the end of the pulse the checking resonator (Fig.2). The width of the checking resonator pulse ( ringing time) should be 4 to 5 km. If the ringing time is considerably shorter as compared with the above given, the tuning of the r.f. circuits of the receiver is to be inspected ( See Chapter II, § 3), as well as the magnitude of the average current of the transmitter magnetron. If necessary, the respective circuit should be adjusted. If no satisfactory results are obtained by alignment of the r.f. circuits of the receiver, the receiver sensitivity has to be inspected ( see Chapter IV, §26). Also the average power of the transmitter should be checked and the respective units should be adjusted and repaired.

1) Read the indications of the scales of the checking resonator ( right scale-integral numbers, left scale-fractions). The magnetron frequency may be obtained from the charts witch on the cover of the resonator or in its instruction book.

19) Cut off the power-supply of the radar.

CHAPTER II

## Replacement of tubes, tuning and alignment of the R.F. circuits --of the IICb H-M equipment.

The replacement of tubes, with the exception of the special r.f. tube types, is simple and convenient and does not differ from the replacement of tubes in current radio equipment.

The replacement of tubes which need to be selected due to great differences in the parameters of the respective tube types ( for example the tubes in the intermediate frequency amplifier of the receiver and some tubes in the range unit and the PPI) is to be performed from special spare parts reserve). Such tubes must be replaced by tubes, specially selected in the factory and marked with the same numbers as the tubes being replaced. If such special tubes are not at disposal, convenient tubes have to be selected. The tube is considered as suitable if the circuit in which the replacement took place, fulfils the requirement of the technical conditions after being tuned by means of the respective controls. The alignment methods are described in Chapter IV " Instruction of the radar bomb sight PC 7-M according to technical conditions."

The replacement of the r.f. tubes ( the magnetron, klystron, antenna T-R tube) and the detector is different from some points of view, and after the replacement of any of those tubes a supplementary tuning of the r.f. circuits of the radar bomb sight equipment is to be performed.

### 1. Replacement of special r.f. tubes

Special r.f. tubes are installed in the lower part of the transmitter ( see Fig.3). For their replacement the transmitter cover must be removed. The replacement of the tubes must be done with disconnected power-supply of the equipment ( this concerns especially the magnetron tube).

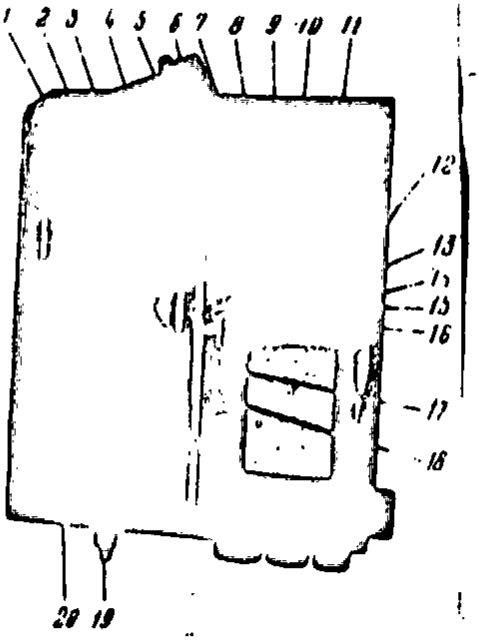


Fig.3. Transmitter with cover removed:
1 - cover of the T-R tube, type RR-6 ( L 1108)
2 - Magnet, type MP-1101
3- exhaust-fan mouth
4 - Magnetron, type MI-53 ( L 1107),5 - Magnetron holding screw, 6 - screw holding the magnetron joint, 7 - klystron shield, 8 - adjusting screw of the mechanical tuning of the klystron tube, 9 - klystron tube type K 19 (L 1110) 10 - cover of the klystron shield, 11 - detector holder, 12 - key for tuning of the klystron tube, 13 - key for alignment of the T-R tube, 14 - locking screw of the detector holder, 15 - adjusting screw of the RR 11 T-R tube, 16 - locking screw of the RR-11 T-R tube, 17 - T-R tube, type RR-11 ( L 1109), 18 - lid of the trigger elevtrode of the T-R tube, 19 - fitting of the P 1101 switch, 20 - resistor, type P 1118.

Replacement of the MII-53 magnetron.

The magnetron replacement is done in cases of poor performance of this tube. Faulty function of the magnetron is indicated by the following effects:

a) After the transmitter is cut on the "Magnetron current" meter indication is zero, and the rectifier current has a small value.

b) Instability or sharp increase of the magnetron current.

c) Magnetron " Sparking" indicated by the vibration of the pointer on the scale of the "Magnetron current" meter; after the magnetron current is decreased, the "Sparking" goes on.

d) Decrease of the average power of the transmitter with normal value of the magnetron current.

N o t e: The above described effects need not be caused exclusively by inadequate performance of the magnetron; they could also appear as results of faults in some transmitter circuits. Thus for example the absence of the magnetron current with a small rectifier current ( of the order of 1 to 5 ma) may be caused by a failure in the magnetron heating transformer. A sharp increase of the magnetron current may be caused by failure of the S 1118 condenser or the GMI-83 tubes. The reason of the decrease in average transmitter power may be found in the de-magnetization of the magnetron permanent magnet, etc.

The magnetron tube is replaced in the following way:

1) Remove the exhaust-fan mouth ( Item 3 in Fig.3.); loosen two screws holding the locking yoke of the fan motor.

2) Remove the four screws holding the magnet (2), and remove the magnet.

3) By means of a special steel plug remove the upper two screws (6) and loosen the lower two screws holding the waveguide output flange of the magnetron; disconnect the magnetron from its waveguide.

N o t e: No steel or iron objects may be placed in the vicinity of the MP-1101 magnet ( pliers, screw-drivers, keys etc) as this would de-magnetize the magnet.

4) Remove the six screws (5) locking the magnetron flange (4) and remove carefully the magnetron tube.

Install carefully a new magnetron tube and be sure, that the base heating pins of the magnetron touch reliably the contacts of the receptacle.

Fasten the magnetron and its waveguide flange. Replace the magnet and the exhaust fan mouth. Tighten the screws holding the parts mentioned.

After the replacement of the magnetron the current of the magnetron should be checked, and also the performance of the transmitter unit should be inspected ( see § 2 of this chapter). By means of the checking resonator tune the r.f. circuits of the radar receiver ( see §3 of this chapter). The magnetron frequency should be measured.

Replacement of the klystron, type K19 ( L 1110 "Scanning").

Faulty function of the klystron tube is indicated by the following effects: considerable decrease of the noise in the monitoring tube display and indication of zero current on the scale of the "detector current" metre in all positions of the "Receiver tuning" control knob. Notice should be taken of the fact that the faulty function of the detector is indicated by effects similar to those of the failure of the klystron. In addition, the faulty performance of the klystron may be caused by a defect in the power-supply circuit of the klystron. Hence the performance of the detector and the power-supply circuits should be tested previous to the replacement of the klystron.

The klystron replacement is done in the following sequences:

Loosen the locking screw of the klystron shield (7) and remove it.

Remove the lid from the klystron repeller electrode.

Open the position fixing key of the klystron by turning the screw on this key in anti-clock-wise direction.

Loosen the holder of the klystron and carefully remove the klystron, together with its holder.

By means of a screw-driver take out the spring ring of the klystron-holder and then remove the klystron from its holder.

Install another klystron tube into the holder, in the following order.

a) Insert two or three adjustment rings into the klystron holder.
b) Install the klystron and two insulation semi-rings into the holder.
c) Lock the klystron in its holder by means of the spring ring.
Install carefully the klystron with its holder into the respective receptacle.
Tighten loosely the klystron holder nut.
Align the r.f. circuits of the receiver ( see §3 of this chapter) and afterwards tighten completely the klystron holder and install the klystron shield in its place.

Replacement of the T-R tube type RR-11 (L 1109).

Faulty performance of the T-R tube is manifested by failure of the detector after the transmitter is switched on or by decrease of the receiver sensitivity.
The T-R tube replacement should be done in the following order:
1) Remove the lid (18) from the trigger electrode of the RR-11 T-R tube (17).
2) By means of the plugloosen the two upper screws (16) and remove the two lower ones and take out the T-R tube.
3) Install a new T-R tube and tighten the screws.
4) Align the T-R tube as described in § 3 of this chapter.

Replacement of the T-R tube, type RR-6 ( L 1108)

Faulty performance of this tube is manifested by a strong decrease of the power output of the transmitter with a correctly operating magnetron, modulator etc.
The replacement should be done in the following sequence:
1) Open the shield (1) of the T-R box.
2) Remove the right locking nut and, while holding the lower part of the T-R box, remove the left locking nut.
3) The T-R tube should be taken out simultaneously with the lower part of the T-R box.
4) Install a new T-R tube.

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Replacement of the detector, type DK-C3.

Faulty performance of the detector is manifested by zero indication of the "Detector current" meter and the decrease of noise level on the screen of the monitoring CRT.

The performance of the detector may be checked by means of the ampere-volt-ohm-meter, type TT-1, or the detector testing instrument, type IKD-1. In this testing the resistance of the detector is measured with successive positive and negative voltages to its ends. If the resistance is large with one polarity, and small with the other, the detector is in order. This measurement may be done on a detector installed in its holder ( the detector holder must be taken out from the mixer cell, previous to measurement). One of the conductors from the measuring instrument is connected to the detector holder, while the other touches the protruding pin of the detector.

The replacement is done in the following order:

1) Loosen partly the locking screw (14) and remove the detector holder (11) from the mixer cell.
2) Loosen the screw on the detector holder. The detector should now fall freely out of its holder. If the detector is held inside the holder, it should be extracted by means of a pincette.
3) Insert a new detector into the detector holder.
4) Tighten the screw and install the detector holder into the mixer cell.
5) Adjust the depth of the inserted detector according to the indication of the "Detector current" meter, and re-adjust the tuning of the r.f. circuits of the receiver ( see §3 of this chapter). Then tighten the locking screw.

§ 2 Alignment and checking of the transmitter performance.

Under operational conditions, the adjustment of the transmitter is restricted to the control of the required value of the magnetron current. The adjustment of the magnetron current is done after replacement of the magnetron, after replacement or re-magnetization of the magnetron permanent magnet, and sometimes after the replacement of the tubes in the modulatoe (GMJ-83) or in the driver

(C[illegible]n addition, the adjustment is sometimes advisable with a c[illegible] value of de-magnetization of the permanent magnet, however, [illegible] should take place only under such circumstances where the induction in the magnet gap is not under a certain admissible value. The measurement of the induction in the gap of the magnet is done by means of the magnetic-induction meter, type GMJ-1. The induction should be 4,700 to 4,900 gauss.

A. Adjustment of the magnetron current.

The magnetron current is adjusted in the following way:

a) In steps- by changing the position of the P 1101 switch (Item 19 in Fig.3). This switch has four positions: in position No.1 the minimum current is obtained, in position No.3 the maximum, and in position No.4 the current is turned off.

b) continuously- by means of the R 1118 resistor (Item 20 in Fig 3). The axle of this resistor is accessible from the front panel of the transmitter ("Magnetron current control").
The adjustment is done in position "100" of the "Range in km" switch; the magnetron current value should be 10 ma.

2) If a new magnetron is replaced, the adjustment should begin with small current values, hence the respective switch is to be set to position "1" previous to the beginning of the adjustment, and the knob of the R 1118 resistor should be turned in anti-clockwise direction to its extreme position. After several minutes the axle of the R 1118 resistor should be turned to increase the current value to 10 ma. If the required current value cannot be obtained by adjusting the R-1118 potentiometer, the transmitter should be cut off, the respective switch should be set to its next position and further adjustment should be done by means of the R 1118 resistor.
The adjustment should be done with a powersupply voltage of exactly 115 V.

3) The current of the magnetron should then be checked in other regimes of operation. The magnetron current in the position "10-60" of the "range" switch should be 6-8 ma. In position "Beacon" of the "Beacon-Scanning" switch the magnetron current should be approximately 10 ma.

If in any of the operation regimes the pointer of the "Magnetron current" meter vibrates ( magnetron sparking) at the above given current values, the current should be decreased to such a value at which the magnetron operation is not disturbed by sparking.

Under such conditions ( viz with current decreased) the magnetron should operate for 10- 15 minutes. After that time the magnetron current should be again increased to the normal value. If the magnetron sparking appears again, the magnetron should be replaced.

B- Checking of the transmitter performance.

1) The magnetron current should be measured with the power-supply voltage of 115 V and with the "Magnetron current-Rectifier current" switch in position "Magnetron current". The magnetron current should be:

a) 10 ma in the position "Scanning"of the "Beacon-Scanning" switch, and in the position "100" of the "Range in km" switch.

b) 6-8 ma in position "Scanning" of the "Beacon-Scanning" switch and in position "10-60" of the "Range in km" switch.

c) 9-12 ma in position "Beacon" of the "Beacon-Scanning" switch.

An increase of the magnetron current as compared with the above given current magnitudes is a mark of faulty performance of the transmitter ( de-magnetization of the permanent magnet, failure of the magnetron, etc.).

The decrease in the magnetron current may be caused by faults in the GM I-83 and GU-29 tubes.

Increased current values with individual types of operation may be caused by faulty function of the shaping circuits in the driver and the GMI-83 and GU-29 tubes.

Caution: The replacement of the GMI-83 and GU-29 tubes in the modulator and driver, respectively, must be done with the disconnected power-supply of the whole equipment. The same is valid for the replacement of the rectifier tubes V1-3,02/20.

2) Set the "Magnetron current-Rectifier current" switch to position "Rectifier current" and check the rectifier current magnitude in all types of operation of the equipment in the same way as described above with the magnetron current measurements.

The rectifier current may not surpass the previously measured current values of the magnetron by more than 5 ma.
If the rectifier current exceeds the above given value, the GMI-83 tube must be replaced.
This kind of failure sometimes appears progressively, not abruptly, after some time of uninterrupted transmitter operation. The rectifier current progressively increases with time, while on the other hand the magnetron current rather decreases. Thus after some 20-30 minutes the rectifier current may exceed the magnetron current by 2-2,5 times.

3) Set the monitoring tube switch to position "2". The modulator pulse display should appear on the screen ( with the "10-60" range the "Expansion of the center" control should be close to its "0 km" position).
With correct performance of the circuit the modulator pulse should not cross the sweep trace ( see Fig.34 a, Chap.IV, §29 item 8).
If that part of the sweep trace which crosses the modulator pulse is presented on the screen ( see Fig.34b), the production of pulses in the transmitter is irregular.
This failure may be caused by small voltage of the pulse which fires the transmitter ( failure of the L 403 (6N8S) tube in the range unit, or of the L 1101 (GU-29),,L 1102 and L 1103 (VI-0,02/20) tubes in the driver). Also a spark-over in the GMI-83 tubes in the modulator unit may be the cause of faulty operation.

## § 3. Receiver tuning.

In field operation, the r.f. circuits of the receiver, the time gain ( anti-clutter) control and the automatic frequency control should be aligned. The alignment of the intermediate frequency amplifier and video amplifier is done in repair shops.
The alignment of the r.f. circuits of the receiver is done after the replacement of the magnetron, klystron, detector or T-R tubes ( type RR-11), and if the sensitivity of the receiver is insufficient in spite of good performance of the intermediate frequency and video frequency amplifiers.

The tuning should be done by means of the checking resonator ( resonant cavity wave-meter); however, if necessary, reflected signals may be used for the adjustment.

The alignment method used is the following:

1) Remove the cover from the transmitter.
2) Install the checking resonator type 50 I at a distance of 4 to 5 meters from the antenna of the radar bomb sight and attach to it the horn antenna of the 50 I accessory equipment by means of the waveguide joint.

Note: If the receiver is being aligned in the repair shop, the radar bomb sight antenna need not be connected to the transmitter, as the horn antenna from the 31 IM, 34 IM, 43 I or other instruments may be used instead. The horn antenna should be connected to the waveguide output of the transmitter.

3) Turn the horn antenna of the 50I equipment towards the radar bomb sight antenna.
4) Set all the switches on the tested radar equipment to their respective initial position ( see Table 1) and cut on the power supply of the equipment tested. The "Power mains 27V-115V" switch and the "Transmitter heating" switch should be set to position "On".
5) Set the "Calibration marking" switch on the timer and control unit panel to position "Off". The "R.f.gain" control knob turn in clockwise direction to its extreme position. The "Expansion 10-60" control knob turn in anti-clockwise direction to its extreme position ( the "Range in km" switch should be set to position "10-60").
6) Turn on the transmitter high-voltage supply; by means of the "Tuning" control knob of the 50I instrument within the limits of 8 to 11 and 25 to 28 great scale divisions, the maximum indication of the microamperemeter on the front panel of the 50I instrument should be obtained.

The attenuator control of the 50I instrument should be turned in anti-clockwise direction to its extreme position ( i.e. to minimum attenuation).

7) By turning the antenna of the tested equipment and the horn antenna of the 50I instrument the maximum indication of the pointer

of the microamperemeter of the 50I instrument should be obtained.

8) Set the "Detector current-Power supply check" to position "Detector current" and turn the "Receiving tuning" control knob from one extreme position to the opposite to find, from the pointer of the meter, the value of the detector current; the current should be within the limits of 0,4 and 0,9 ma.

9) Adjust the optimum position of the detector. Loosen the locking screw of the detector holder ( Item 14 in Fig.3) and slowly pull in or out the detector until the maximum current is obtained. After this the locking screw should be tightened. If the detector current is smaller than 0,4 ma, the coupling between the klystron and the mixer cavity should be tightened. To increase this coupling remove the shield ( Item 7 in Fig.3) off the klystron and turn the yoke of the klystron holder in clockwise direction. If the detector current exceeds the value of 0.9 ma, the yoke of the klystron holder should be turned in the opposite direction, viz. in anti-clockwise direction. The detector current obtained is usually from 0,6 to 0,7 ma. Then the shield is to be returned to its position.

N o t e : The body of the klystron is at a potential of 300 V, and thus the adjustment is to be performed carefully.

10) Shift off the cover ( Item 10 in Fig.3) on the klystron shield and put the key ( Item 12 in Fig.3) into the screw of the mechanical tuning of the klystron (8).

Turn slowly the key ( only in 90° steps) in clockwise direction, and simultaneously turn the "Receiver tuning" control on the panel of the timer and control unit through all its tuning range, until the signal of the checking resonator is presented on the screen of the monitoring CRT ( Fig.4a).

If the screw of the mechanical tuning of the klystron is turned to its extreme position and the signal display is still absent, the key should be turned in anti-clockwise direction to the appearance of the signal display.

During the alignment of the receiver the tuning of the checking resonator should be re-adjusted each 5-10 minutes ( by means of the maximum indication of the microamperemeter installed on the front panel of the 50I instrument).

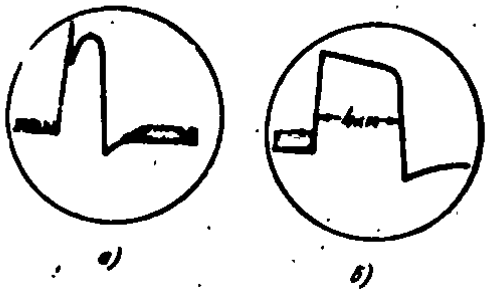



Figure 4 - Display of the signal of the checking resonator on the screen of the monitoring CRT during the tuning of the receiver.
a) pulse of the checking resonator prior to perfect alignment of the receiver,
b) the pulse of the checking resonator after the receiver is correctly tuned.

11) Check the correct adjustment of the klystron and, at the same time, besure that the klystron is not tuned to the image-channel ( with the correctly tuned klystron the klystron-frequency should be lower than the magnetron frequency). For this the following should be done:
a) Set the switch of the monitoring tube to position "3", Turn the "Expansion of the center" control knob installed on the computing mechanism unit panel until the display of the transmitter pulse on the screen of the plan position indicator is brought to the center of the sweep, and pulse signalling the operation of the automatic tuning circuit appears on the monitoring CRT screen.
b) Turn the "Receivor tuning" control knob in clockwise direction. With correct alignment the signal display should follow in this sequence: the sweep trace is first bent upwards ( Fig.5a), then the signal corresponding to the accurate tuning of the klystron is presented ( Fig.5b) and finally the signal is bent downwards (Fig.5c) If an inverse sequence is obtained, i.e. if with turning the "Receiver tuning" control knob in clockwise direction the signal

display is bent downwards and upwards bent signal 50X1-HUM terwards, the klystron is tuned to the image channel ( the klystron frequency is higher than that of the magnetron).

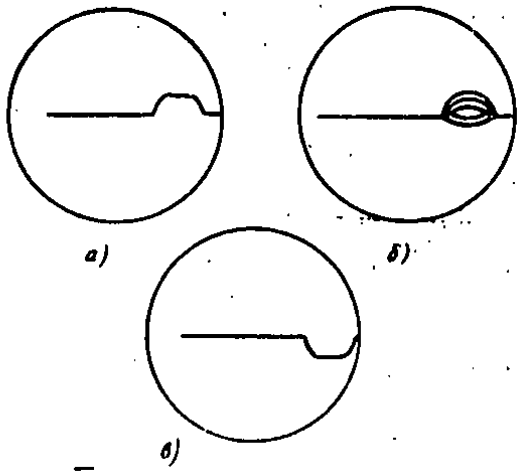



Figure 5: Display of the automatic frequency control pulses on the screen of the monitoring tube during the turning of the "Receiver tuning" control knob in the clockwise direction:
a) display preceding the accurate tuning of the klystron
b) display corresponding to the accurate tuning of the klastron
c) display after the tuning point of the klystron is passed.

In such case the monitoring tube switch has to be set to position "1" and the tuning of the klystron circuit should be repeated (turn the screw of the mechanical tuning of the klystron in clockwise direction ( until the pulse of the checking resonator appears on the screen of the monitoring tube. The correct tuning of the klystron has to be checked once more in position "3" of the monitoring tube switch.

12) Set the monitoring tube switch to position "1" and adjust the optimum tuning of the klystron ( i.e. the coincidence of the maximum width of the checking resonator pulse display on the monitoring tube with the maximum indication of the poiter of the

"Detector current" meter). Turn the "Receiver tuning" control knob in clockwise direction. If first the maximum signal ( i.e. the maximum width of the checking resonator pulse display on the screen of the monitoring tube) appears, followed by the maximum of the detector current, the tuning screw of the mechanical tuning of the klystron should be slightly turned in anti-clockwise direction. If with turning of the "Receiver tuning" control knob in clockwise direction first the maximum of the detector current appears followed by the maximum signal the screw of the mechanical tuning of the klystron should be turned in clockwise direction until the respective maxima of the detector current and checking resonator pulse width coincide.

13) By shifting the detector holder the maximum indication of the "Detector current" meter should be obtained.

14) Turn the screw of the RR-11 T-R tube to obtain the maximum width of the checking resonator pulse on the monitoring tube screen.

15) Turning the yoke of the klystron holder adjust the maximum value of the detector current between 0,6 and 0,7 ma.

16) For higher occurancy adjust again the tuning of the klystron, the RR-11 T-R tube and the detector. If all the elements are correctly aligned, the width of the pulse of the checking resonator should be 5 - 4,5 km ( the attenuation control knob of the checking resonator should be tuned in anti-clockwise direction to its extreme position).

17) Check the performance of the automatic frequency control and align the respective circuits. Set the "Manual-Automatic" switch to position "Automatic". Doing this the display of the pulse of the checking resonator should not change and also the detector current value should remain stable. The turning of the "Receiver tuning" control knob within the limits of $50^{\circ}$- $60^{\circ}$ should cause neither the disappearance of the display nor the vibration of the pointer of the "Detector current" meter.
If the performance of the automatic frequency control circuits is not satisfactory, i.e. the pointer of the "Detector current" meter vibrates and irregularities in the signal display occur, the "AFC adjustment" control knob should be turned until the vibration of the pointer cease and a reliable display of the checking resonator pulse is obtained.

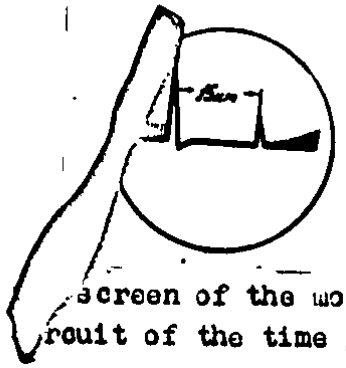
ompare the width of the checking resonator pulse wi
nd automatic control of the frequency. If the pulse width with
he AFC is smaller than with the manual frequency control, the
uning of the klystron should be inspected ( see Item 11).

18) Switch in the system of fast antenna rotation and check the reliability of the performance of the automatic frequency control circuit. During the antenna rotation the value of the detector current should be approximately constant ( variations within 0.1 ma are admissible).

19) The preliminary altitude tuning of the klystron has to be done now. For this screw of the mechanical tuning of the klystron should be slightly turned in clockwisw direction. The value of the detector current in the position where the receiver is tuned to the signal maximum should be lower by 15-25% as compared with the maximum of the detector current.

Set the "automatic-manual" switch to position "Manual" and deflect the antenna of the radar equipment from the direction of the checking resonator. Inspect the operation range of the system of the time gain control in the beginning of the sweep trace. Turn the "Time gain" control in clockwise direction to its extreme position.

The noise display on the screen of the monitoring CRT should be suppressed in the range of 15-20 km to the right of the transmitter pulse. display and after this range the noise amplitude should progressively increase ( see Fig.6).



ig.6 : Display on screen of the monitoring CRT with the checking of the circuit of the time gain control.

If the range of activity of the time gain control system is smaller than the above given, the adjustment is done as follows:

a) Turn the "Time gain" control knob in clockwise direction to its extreme position.

b) Turn the "Range" control installed on the panel of the computing-mechanism unit to obtain a measurement pulse at a distance of 15 - 20 km from the transmitter pulse display.

c) Turn the axle of the "Time gain control" potentiometer accessible from the left side panel of the timer and control unit and adjust the required operation range of the time gain control system.

## CHAPTER III

## MAINTENANCE OF THE RADAR BOMB SIGHT, TYPE IICbH-M

In this chapter the order of the inspection of individual units prior to start of the aircraft and after its landing is described, as well as the extent of the work to be performed.

### § 1. Inspection of the radar bomb sight equipment in the IL-28 aircraft prior to start.

1) Inspect the outside surface of the radome of the radar bomb sight ( cleanliness) and, if necessary, wipe the radome with a wet cloth ( do not use petrol for washing).
2) Through the opening in the fore leg of the aircraft undercarriage check the fastening of the transmitter, the air pump and the MA-1500 K power convertor. Be sure that the connectors and hermetical joints and the rubber hose of the pump are reliably fixed.
3) Check the pressure in the transmitter and, if necessary, pump the air into the transmitter cover to obtain a pressure of 0,4 atm. ( in the equipment of the 1950-1951 series).
4) In the navigator's cabin inspect the fastening of all units of the equipment and be sure of the reliable connection in all terminals and their respective connectors.
5) Set all switches and control knobs of the equipment to their respective initial positions ( Chapter I, §1).
6) Connect the cable from the airfield power-supply ( AIIA-2, AIIA-7 or ST-182) to the airborne power-mains network.

Cut on the heating system of the radar bomb sight.

Check the performance of the equipment according to instructions in Chapter I, §2.

Check the range calibration of the coupling unit of the optical bomb sight and, if necessary, adjust the unit in collaboration with the navigator, as described in Chapter I, §3 B.

10) Cut off the power-supply of the radar bomb sight and set all switches and controls to their respective initial positions.

§ 2. Examination of the radar bomb sight equipment after landing.

After landing of the aircraft interview the navigator on the performance of the equipment and write down in the log book all comments concerning the performance of the equipment during the flight. Then examine the equipment and write down in the log book all failures observed. It is prohibited to repair any failure before the examination is finished.

The inspection should be done in the following sequence:

Check the fastening of the radome of the radar antenna. Look for any mechanical damage of the radome. If the radome is dirty (oil etc). wash it with hot water and soap.

Open the cover of the opening in the fore leg of the aircraft under carriage and inspect:

a) The fastening of the transmitter, the pump, the pump pressure gauge, the reverse relay, the MA-1500K power convertor and the waveguide. Also look for any mechanical damage of these units.

b) Reliable connection of terminals with their respective connectors of the units of the transmitter, the pump, the reverse relay, the MA-1500K power convertor and the hermetical joints in the floor of the navigator's cabin.

c) The thightness of the nuts on the air pump in the waveguide system.

d) Fastening of the cable to the fuselage of the aircraft. Check also the absence of abrasion of the cable envelopes and the absence of contact of cables with the metal edges of the doors.

) Absence of paraffin-oil spots and of objects not appertaining to the radar equipment on the inside surface of the radome. Should paraffin-oil spots be found, the radome should be removed and washed with hot water and soap.

Check in the navigator's cabin:

) The fastening of the units and the absence of mechanical damages of the equipment units, the integrity of meter glasses, the correct functioning of the switches and control knobs of the equipment.

b) The reliability of contact in the connectors.

c) The fastening of the cables to the fuselage in the cabin.

4) Repair the damage observed during the flight and during the inspection after landing. After the repair the performance of the whole equipment should be inspected as described in Chapter I., § 2.

## § 3. Regular maintenance of the radar bomb sight equipment.

The regular maintenance of the radar bomb sight should be performed after a certain number of flight hours.

Such work is divided into the following categories:

1) Maintenance work after 25 hours of aircraft flight.
2) Maintenance work after 50 hours of aircraft flight.
3) Maintenance work after 100 hours of aircraft flight.

### Maintenance work after 25 hours of aircraft flight.

1) Remove the radome of the radar bomb sight and check its surface. If dirt paraffin-oil spots etc. are found, wash the inside and outside surfaces of the radome with hot water and soap.
2) Check the fastening of the transmitter and the antenna assembly of the radar bomb sight, as well as of all the units of the antenna rotation system. Examine the drainage opening in the MPR-2 mechanism ( i.e. the antenna rotation system). If the opening is blocked, clean it with a thin needle.
3) Examine the waveguide. If it is mechanically damaged, ( shock, pressure, etc.) replace the waveguide.
4) Move off the dust and dirt from all units.

5) Disconnect all connec[illegible] as well as the hermetically sealed terminals [illegible] the navi[illegible]r's cabin. [illegible]f the inside of the terminals [illegible] appl[illegible] pressure to remove the moist.
6) Cut off the radar power-supply and check the reliable performance of all switches on the panels of the timer and control unit, the azimuth stabilization unit and the respective control boxes of the sector scanning, the power-converter and the timer and control unit.
7) Check the hermetical sealing of the waveguide [illegible]m as described in Chapter IV, § 32, and examine the ope[illegible] the heating system.
8) Inspect the operation of the radar bomb sight [illegible] the checking resonator as described in Chapter I, §§ [illegible]
9) Check the calibration of the computting mechanism un[illegible] Chapter IV, §12).
10) Inspect the performance of the coupling unit of the [illegible]ical bomb sight ( Chapter I, §3) If the adjustment of the bank channel was performed, inspect the radar bomb sight by means of the corner reflector; if necessary, adjust the radar bomb sight as described in Chapter I, §4.
11) Replace the radome of the radar bomb sight antenna.

Maintenance work after 50 hours of aircraft flight.

2) Perform the work described in Items 1, 3, 4 and 5 of the instruction for maintenance work after 25 hours of flight.
3) Remove the transmitter, the timer and control unit, the power supply unit, the azimuth stabilization unit and the coupling unit of the optical bomb sight from their respective shock absorbing frames and take off their covers.
4) By means of the tube-tester, type IL-12 or 1-177 check all tubes, except the transmitter tubes and the CRT. All tubes must be removed from their receptacles and immediately marked with their respective numbers.
4) Check the absence of external mechanical damages of the units, the fastening of the outside components, the contact in the connectors, the cleanliness and the absence of corrosion on the

contact surfaces of the connectors. Examine the correct functioning of all switches and reliability of their fasting in their respective positions as well as the absence of excessive friction or loose coupling in the rotation elements of the tuning controls. Inspect the fastening of the components inside the individual units of the equipment. Examine the fastening of all components. Check the desicator in the transmitter unit and, if necessary, replace the silicagel in the desicator.

5) Remove the belts from the D 7 motors of the exhaust fans and the pump and check the height of the brushes which should be 8 mm at least. If the brushes are shorter then the above given length, replace them from the spare parts reserve.
Examine the collector ( burning) as well as the brush springs and the free movement of the brushes in their holders. If the collector is covered with burnt carbon or dirt, wipe it with a clean cloth slightly moistened with alcohol or B-70 petrol . The dirt on the collector which cannot be removed with the cloth should be wiped off with a soft glass-paper. No.0).
Clean the gaps between the lamellas by means of a sharped wood-plug and apply compressed air to the interior of the motor.

6) Replace the belts on the motors of the fans and the pump, and install the checked tubes. The tubes which were found unreliable in the checking replace by new tubes from the spare parts reserve. Install all units into their respective covers, except the timer and control unit, and put them to their respective places. Connect the cable connectors to their respective units.

7) Remove the wire-lock and loosen the brush inserts of the electrical mechanism, types MPR-2 and MPR-3. Check the height of the brushes which should be 17 and 7 mm at least in the type MPR-2 and MPR-3, respectively. The brushes shorter than the above given length replaces from the spare parts reserve. Apply compressed air to the interior of the electrical mechanism. Examine the free movement of the brushes in their holders. Replace the brushes, and close and lock the inserts.

8) Remove the cover of the azimuth differentiating mechanism covering the key switch of the sector scanning system. Remove the key switch of the sector scanning system and wipe off the burnt carbon from the contact surface of the key and of other

contacts by means of a clean cloth moistened with alcohol or petrol.

If the contact surface of the sector scanning key switch is considerably burnt, replace the contact.

Install the key switch of the sector scanning system to its place.

9) Cut on thepower - supply of the radar bomb sight and inspect some of the characteristics of this equipment according to the data given in Chapter IV, especially the following:

a) The values of the D.C. voltage produced by the power-supply ( see § 3).

b) The brightness and focus of the plan position indicator tube and the monitoring CRT ( see § 4).

c) The centering of the respective sweep traces of the plan position indicator and the monitoring CRT ( see § 5).

d) The frequency division circuits in the range unit ( see §6)

e) The sweep rations ( see § 7).

f) The performance of the system of step ( discontinuous) time delay of the sweep beginning ( see § 10).

g) The range and accuracy of performance of the system of continuous delay of the sweep beginning ( see § 11).

h) Variation in the brightness of calibration marker display.

ch) The position of the course line and the longitudinal marker as well as the variation in their brightness ( see § 13).

i) Rotation speed of the antenna system ( see § 14).

j) The performance of the antenna assembly in sector scanning and the position of the center of the front scanning sector in reference to the longitudinal marker ( see § 15).

k) The functioning of the antenna tilting system ( see § E).

l) The rectifier current and the magnetron current values ( see Chapter II, § 24) .

m) The performance of the automatic frequency control ( see Chapter II, §3).

n) The operation range of the time gain control ( see Chapter II, §3).

o) The preliminary altitude tuning of the klystron.

) Disconnect the waveguide from the transmitter and inspect by means of the 31 IM instrument the following:

a) Check the average power of the transmitter.
b) Check the frequency of the transmitter.
c) Examine the sensitivity of the receiver.

Connect the waveguide to the transmitter, replace the cover on the timer and control unit.

Examine the performance of the course channel and the back channel of the coupling unit of the optical bomb sight ( see Chapter I, § 3, C,D,).

13) Check the accurancy of the calibration of the range channel of the coupling unit of the optical bomb sight (Chapter IV, §22E)

14) Inspect the adjustment of the radar bomb sight by means of the corner reflector ( see Chapter I, §4).

15) Check the hermetical sealing of the pump and the transmitter ( Chapter IV, §§ 31 and 32).

16) Install the radome of the radar antenna.

The maintenance work to be performed after 100 hours of aircraft flight.

1) Remove all units of the radar bomb sight from the aircraft, except the T-junction and the connecting cables.

2) In the workshop perform the operations described in §§ 3,4,5,6, 7 and 8 of this instruction on the maintenance after 50 hours of flight.

Install the radar bomb sight of the stand and tune the receiver ( see Chapter II, § 3).

Inspect the fundamental technical characteristics of the radar bomb sight equipment according to Chapter IV, especially the following:

a) The characteristics of the timer and control unit according to Item 9, points (1) to (16) of the instruction on the maintenance work after 50 hours of aircraft flight.
b) The limits and the speed of tilt angle movement in the antenna system, as well as the accurancy of the indication of the antenna tilt indicator ( see § 16).
c) The accurancy of the coincidence of the sweep trace rotation with the antenna system rotation ( see § 17).
d) The performance of the system of the azimuth stabilization ( see §§ 18 and 19).

e) The amplitude value of the firing pulse of the transmitter exciter, produced in the range unit ( see §20).

f) The constant error of the range measurement ( see § 21).

g) The accurancy of the performance of the coupling unit of the optical bomb sight ( i.e. the positions of the transverse and longitudinal marks, the accurancy of the course channel performance, the speed of the correction of the angle divergency, the accurancy of the performance of the transverse stabilization channel of synchronization of the slant range ( see § 22).

h) The length of the transmitter pulses ( see § 23).

ch) The average power of the transmitter ( see § 24)

i) The operation frequency of the transmitter ( see §25).

j) The sensitivity of the receiver ( see § 26)

k) The standing wave ratio in the antenna and waveguide assembly ( see § 27).

l) The hermetical sealing of the transmitter of the antenna and waveguide assembly and the performance of the heating system ( see §§ 31 and 32).

) Performance the maintenance work described in Items 1 and 5 of the instruction on the work to be performed after 25 hours of aircraft flight. Examine the cable envelopes and the shock absorbing frames of the individual units of the radar bomb sight equipment.

Install all the units of the radar bomb sight into the aircraft and connect to them their respective cables and the waveguide. With the installation of the waveguide pay attention to the presence of the rubber washers in the connection joints.

Inspect the operation of the radar bomb sight as described in Chapter I, § 2.

Inspect the operation of the coupling unit of the optical bomb sight ( see Chapter I, § 3 or Chapter IV, §3). By means of the corner reflector adjust the radar bomb sight equipment ( see Chapter I, §4).

Replace the radome of the antenna assembly of the radar bomb sight.

6. Operation of the radar bomb sight equipment in low and high temperatures and in increased humidity of air.

If the temperature of the ambient air is under zero°C, special care should be taken of the correct performance of the heating devices as well as on the early beginning of their operation ( the heating of the vertical and horizontal rotating waveguide joints, the pump and the detector). Prior to switching on the radar bomb sight equipment, the heating of the rotating waveguide joints and the pump should be switched in, and the heating case should be included on the optical bomb sight to heat the equipment.

With the temperature of the ambient air under -10°C the radar bomb sight equipment must be heated for 15 to 20 minutes prior to the beginning of the operation.

With the operation of the radar bomb sight equipment at a temperature above +50°C the operation of the equipment must be interrupted after one hour.

If the radar bomb sight equipment is operating in increased air humidity conditions, the units must be wiped off with a dry cloth prior to the operation of the equipment, and the inspection of the equipment ( switching in the " Transmitter heating" switch) may not be started until 15 minutes after the switching in the "Power supply 27 V-115V" switch.

## CHAPTER IV.

## Inspection of the radar bomb sight equipment according to technical regulations.

### 1. Organization of the inspection work.

The methods described in this chapter enable the inspection of individual characteristics of the radar bomb sight equipment by means of several instrument types, as some of the measurement equipments described in this chapter may not be at the disposal in some army units.

The complex inspection of all the technical conditions of the radar bomb sight equipment is performed only after the repair of the equipment.

Many of the technical characteristics may be inspected either with the installed airborne equipment or on the stand in the repair shop. If the methods used in both types of inspectin places do not differ, no instructions are given in the respective paragraphs of this chapter ( for example the inspection of the parameters of the plan position indicator unit, the voltage of the power supply unit, the rotation speed of the antenna assembly). If the method used with the installed airborne equipment differs from that used in the repair shop, the respective notes are given in the description, and methods used in the aircraft are described ( for example the measurement of the power output of the transmitter, the inspection of the sensitivity of the receiver).

Some of the characteristics may be measured only on the stand ( for example the standing wave ration, antenna horizontal radiation pattern, intermediate frequency and the band-pass of the receiver).

For various adjustment of the radar bomb sight equipment as well as for the dismounting and mounting of the individual parts, the tools should be used contained in the instrument box of the radar bomb sight type PSBN-M, as well as the tools intended for the repair of the equipment in workshop.

For the inspection of the radar bomb sight equipment in the workshop several auxiliary tools should be prepared.

The inspection and measurement apparatus should be energized from the airborne 115 V 400 c.p.s. mains. The power supply cables of the inspection apparatus should be connected to the receptacles on the power-convertor control panel. In the repair shops the 200V 50 c.p.s. or 115 V 400 c.p.s. mains should be used.

In the repair shops, also a 27V motor generator with a power-output of at least 3 kW may be used.

The term " out on the radar bomb sight equipment" signifies that a source of D.C. current of 27 V and a source of A.C. current of 115 V 400 c.p.s. should be used, and the "27V-115V" switch and the "Transmitter heating" switch on the timer and control unit panel should be turned on.

## Specific features of the use of the micro-wave measuring apparatus.

1) The waveguide output of the transmitter and the antenna waveguide of the radar bomb sight should be connect to the measuring apparatus by means of special waveguide joints. The reliability of performance of the joints should be continuously checked during the measurement.

The connecting joints are attached in such a way that the broad side of one waveguide element is connected to the corresponding broad side of the neighbouring element. If different polarization of the wave exists in waveguides to be connected ( for example the broad side of the transmitter waveguide is installed in the vertical plane while the broad side of the waveguide of the 431 instrument is in the horizontal plane) a twist waveguide joint should be applied. In other cases always the corresponding waveguide joints should be used. The respective waveguide joint ( i.e. waveguide joint with an inserted quatre-wave stub) of one waveguide should always be connected with the flat joint of the other waveguide. If this is not possible, supplementary waveguide elements with either two flat or two protective joint should be used.

The marking in the diagram of the respective types of flat and protective waveguide elements is shown in Fig.7.

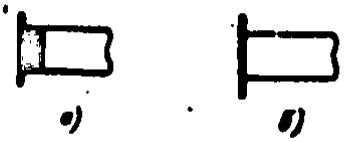



Fig.7. Marking in the diagrams of the waveguide joints:
a - the protective joint
b - the flat joint

In many instruments ( for example the 311M, 331, 351M, 381 or 501 types) crystal detectors are used. Should a great r.f. power be fed to such detectors, they would be damaged. Therefore, the r.f. power supplied to the inputs of such apparatus should never exceed the admissible value of the respective instrument.

he course of the measurement the detectors must often be
l. The detectors are usually tuned by changing the depth of
submergion of the detector holder and by means of the control
ent of the detector cell.
tuning is done according to the maximum indication of the
amperemeter installed on the front panel of the measuring
rument, or from the maximum indication of the voltmeter in-
lled in the 281 amplifier.

nspection of the D.C. voltage produced by the power supply
nits of the radar bomb sight equipment.

ust, by means of the A.C. voltmeter, a voltage of exactly 115V.
means of the ampere-volt-ohm-meter, types AVO-5 or TT-1, mea-
e the voltage values in the receptacles installed on the PL-
panel, placed on the front desk of the power supply unit.-
voltage is measured between the individual respectacles and
chassis of the unit. The respective values of the voltage
sured should be within the limits given in Table 2.

Table 2.

tage values to be measured in the receptacles of the PL-301
el.

| Nominal voltage V | Lower voltage limit | Upper voltage limit | Note |
|---|---|---|---|
| +300 | +270 | +330 | Stabilized |
| -255 | -230 | -280 | " |
| -150 | -145 | -165 | " |
| +105 | +100 | +115 | " |
| 0 | 0 | 0 | - |
| +240 | +240 | +267 | Not stabilized |
| +265 | +252 | +278 | " " |

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§ 4. Examination of the brightness and focus of the plan position indicator and monitoring tubes.

1) Turn the "Brightness" control knob on the plan position indicator control panel and check the variation of the brightness of the sweep on the PPI screen from its maximum value to complete suppression of the trace.
2) Adjust, by means of the "Focus" control knob, the width of the sweep trace to a thin line. Be sure that the focusing does not take place in the extreme positions of the focusing potentiometer.
3) Turn the axles of the "Brightness" and "Focus" potentiometers installed on the front panel of the timer and control unit, and be sure that the brightness and focus of the monitoring tube vary withthe turning of the respective axles. Examine the focusing in both the horizontal and vertical directions, i.e. both the sweep trace as well as the calibartion markers should be focused in the same position of the "Focus adjustment" potentiometer.

§ 5. Examination of the centering of the sweep on the screen of the plan position indicator and the monitoring CRT.

1) Put on the antenna rotation system and examine the position of the beginning of the sweep trace on the screen of the plan position indicator; the beginning should be placed in the center of the screen, and in the crossing point of the filter cursor.
2) Turn the axles of the "Horizontal" and "Vertical" potentiometers ("PPI Centering") accessible from the front panel of the timer and control unit; the beginning of the sweep trace should be moveble at least 5 mm in both the vertical and horizontal directions. In the position where the beginning of the sweep trace is in the center of the PPI screen, the sliders of both potentiometers should be in their respective middle positions. If this is not true, set the sliders of the "Vertical" and "Horizontal" potentiometers ("PPI Centering") to their middle position and loosen the three screws locking the focusing coil on the plan position indicator tube.
Change the position of both the focusing coils and the screws in their longitudinal slots until the sweep trace is placed in the

...le of the PPI screen. Then tighten the screws of the focus... coil and be careful not to shift the beginning of the sweep ...e away from the center of the screen.

...ck the control element of the monitoring tube centering. ... ...n the "Vertical" and "Horizontal" potentiometers ("Cen... ...ring") accessible from the front panel of the timer and con... ...ol unit ( right of the monitoring tube); the sweep trace ...ould shift correspondingly in both the vertical and horizon... ...l directions at least 10 mm.

6. Co... Checking and adjustment of the frequency division in the range unit.

1) Set the "Tube switch" on the panel of the timer and control unit to position "4" and check the 1:5 ratio of the frequency division. On the screen of the monitoring tube a display should be obtained, presented in Fig.8.

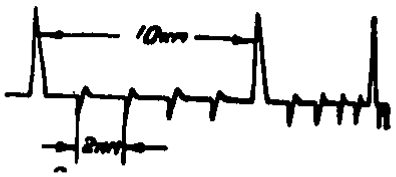


Fig.8. Display of the pulses on the screen of the monitoring tube in position "4" of the tube switch ( division ratio 1:5).

With the 1:5 ratio of division, five two-kilometer zones should be obtained between two positive ten-kilometer markers separated by negative 2-km markers.

If the frequency division ratio is not 1:5, turn the axle of the "1:5 division adjustment" potentiometer, accessible from the left side panel of the timer and control unit, to obtain a ration of 1:5.

Check the ratio of 1:2. Connect the pin "6" ( cathode) of the I 402 (6N8S) tube in the range unit with the input of the vertical amplifier of the oscilloscope type EO-5 or 25 J.

f the inspection taken place on the aircraft, the plug of power-supply of the oscilloscope should be connected to the ...optacle installed on the control panel of the power converter unit. Prior to this the respective switch of the oscilloscope must be set to position "110V").

...n the "frequency" and "Synchronization" controls of the oscilloscope to obtain a reliable display on the screen of the oscilloscope. With the 1:2 ratio of frequency division two tenkilometer zones should be obtained between two positive 20-km range markers. ( Fig.9).

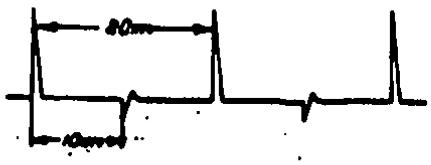

Fig.9. Display of range markers on the oscilloscope screen with the frequency division ratio 1:2.

...onnect the pin "3" ( cathode) of the L 403 (6N8S) tube with the input of the vertical amplifier of the oscilloscope and inspect the frequency division ratio of 1:6, 1:13 and 1:25. In position "10-60" of the "Range in km" switch and position "Scanning" of the "Beacon-Scanning" switch the display on the screen of the oscilloscope should be as seen in Fig.10.- The frequency division ratio should be 1:6. If this is not true, choise another L 403 (6N8S) tube to obtain the ratio of 1:6.

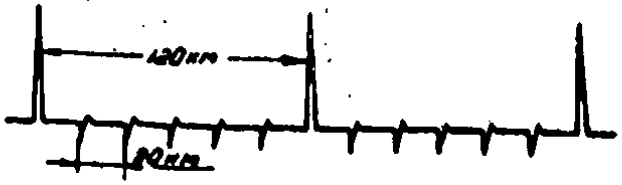

Fig.10.-Display of range markers on the screen of the oscilloscope with frequency division ratio of 1:6.

In positions "100" or "200" of the "Range in km" switch the frequency division ratio should be 1:13 ( Fig.11). If the ratio of the frequency division is greater or smaller than 1:13, the axle of the " 1:13 division adjustment" potentiometer ( installed on the right side panel of thetimer and control unit) should be adjusted to obtain a reliable division ratio of 1:13

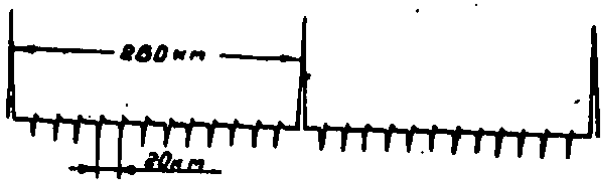


Fig.11: Display of range markers on the oscilloscope screen with a frequency division ratio of 1:13.

Set the "Beacon-Scanning" switch to position "Beacon". The frequency division ratio obtained should be 1:25 ( Fig.12) In this position, the ratios of 1:24 or 1:26 are admissible.

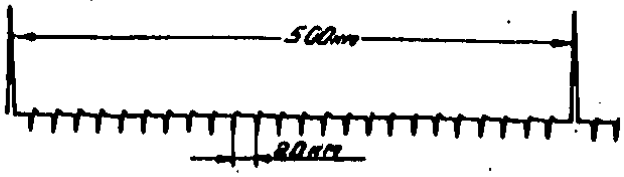


Fig.12: Display of range markers on the screen of the oscilloscope with a frequency division ratio of 1:25.

6. Inspection and adjustment of the sweep ratio.

1) Set the "range in km" switch to position "100" and the "Calibration marking" switch to position "10 km".
2) Turn the axle of the "Sweep control" potentiometer ( accessible from the front panel of the timer and control unit) to obtain a sweep ratio of exactly 100 km. Exactly ten ten-kilometer zones

should be presented now on the screen of the plan position indicator CRT, divided by ten-kilometer range markers ( Fig.13). The last range marker should be placed at the end of the sweep trace.

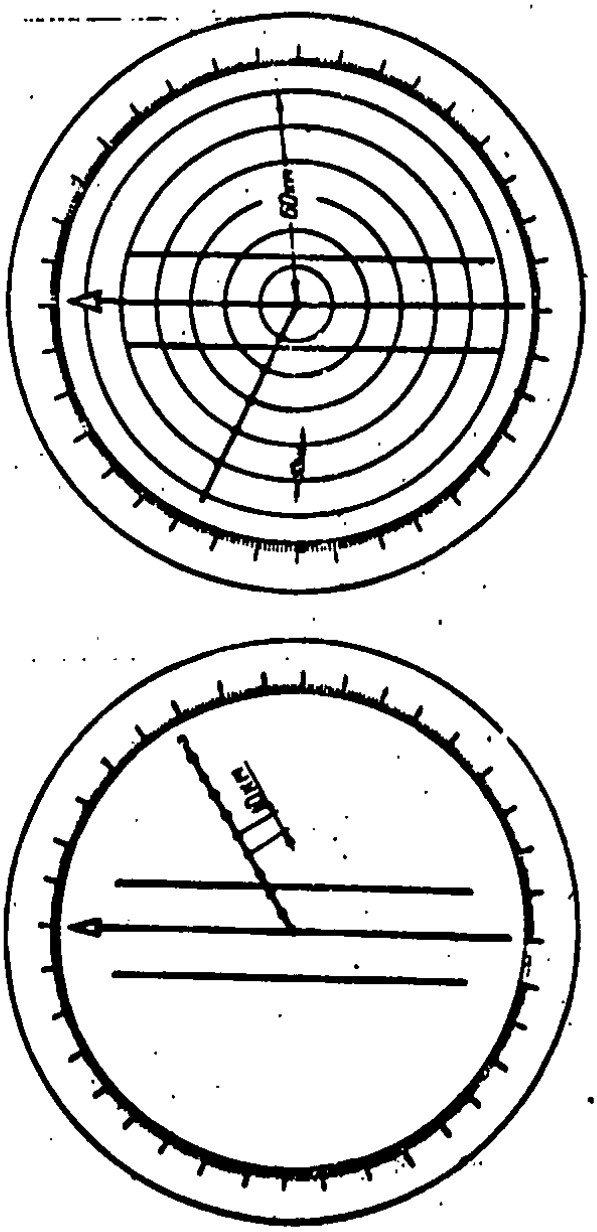


Fig. 13: Display on the screen of the plan position indicator CRT with the inspection of the sweep ratio:
a - 100 km range
b - 60 km range

3) Set the "Range in km" switch to position "10-60" and turn the "Expansion 10-60" control knob in clockwise direction to its extreme position.
4) Cut on the antenna rotation system and adjust the ""Expansion of the center" control installed on the computing mechanism unit to obtain the coincidence of the first calibration marker with the beginning of the sweep.
5) Turn the axle of the "Sweep ratio 10-60" potentiometer and adjust the 60 km sweep ratio to obtain six circular ten-kilometer range markers on the screen of the plan position indicator (Fig. 13b). The lat circular calibration marker should coincide with the end of the sweep trace.
6) Set the "Calibration marking" switch to position "2km" and turn the "Expansion 10-60" control knob in anti-clockwise direction to its extreme position. From the two-kilometer range markers measure the sweep ratio should be $8 \pm 1$ km.
7) Cut off the antenna rotation system. Set the "Range in km" switch to position "200" and the "Calibration marking" switch to position "10km". From the calibration markers measure the sweep ratio which should be within the limits of 190 and 210 km.

§ 8. Inspection of the sweep amplitude variation with the switching of the sweep ratio.

1) Remove the filter glass from the plan position indicator screen. Turn the "Expansion 10-60" control knob ( the "Range " switch is in position " 10- 60") until the amplitude of the sweep achieves its maximum value.
2) Turn the axle of the "Sweep amplitude" potentiometer ( installed on the front panel of the timer and control unit) to adjust the amplitude value of the sweep corresponding to the radius of the screen of the plan position indicator CRT.
3) Set the "Range in km" control knob to positions "100" , "200" and "10-60" and, by turning the " Expansion 10-60" control knob, note the maximum and minimum amplitude of the sweep on the screen of the plan position indicator CRT.
The difference between the maximum and minimum value of the amplitudes of the sweep should not be overv8 mm. Milimeter-scale paper or a ruler are used in the measurement.

§ 9. Checking of the shape-distortion of the calibration circular markers.

1) Set the "Range in km" switch to position "10-60" and the "Calibration marking" switch to position "2km". By means of the "Expansion 10- 60" control knob adjust the sweep ratio of 10 km according to the 2 km range markers.
2) Switch in the antenna rotation system and note the position of the respective maximum and minimum radii of the range circular markers and measure their length ( this measurement should be done with the filtre-glass removed from the PPI screen).
3) Evaluate the shape distortion of the calibrating circular range markers from the following equation:

$$= \frac{R - r}{r} \cdot 100\%$$

where: = the shape distortion in %, R = the length of the maximum radius of the circle in mm, r = the length of the minimum radius of the circle in mm.
The magnitude of the shape distortion of the circular markers should not exceed 10%.
4) Cut off the antenna rotation system.

§ 10. Inspection and adjustment of the step discontinuous delay of the beginning of the sweep.

1) Connect, by a cable, the Šr 401 receptacle, installed on the back side of the timer and control unit, with the input of the synchroscope, type 251. Set the "Sweep" switch of the synchroscope to position "Waiting", and turn the "Time range" switch to position " 250 microseconds".
The "External-Internal synchronisation" switch set to position "Internal" and the "+" "-" switch to position "-". The "Input resistance and attenuation" switch set to position "1:100". Supply the synchroscope from a 200V or 115 V 400 c.p.s. mains (the receptacles installed on the "Power convertor control" panel of the radar bomb sight equipment).

2) Set the switches installed on the panel of the timer and control unit to their respective positions: "Beacon-Scanning" switch to position "Beacon". "Range in km" to position "100" and "Range delay" switch to position "Zero".
3) Cut on the power supply of the radar bomb sight equipment of the 251 synchroscope.
4) Adjust the brightness and the focusing of the display on the screen of the synchroscope CRT tube.
5) By means of the "Continuous" and "Attenuation" control knob on the synchroscope panel set an amplitude value of the pulse, convenient from the point of observation.
If no sweep is presented on the synchroscope screen, or if the display on the screen is unstable, turn the "Gain" control knob, installed in the right lower corner of the front panel of the synchroscope. A display should be obtained on the screen of the synchroscope, shown in Fig.14.

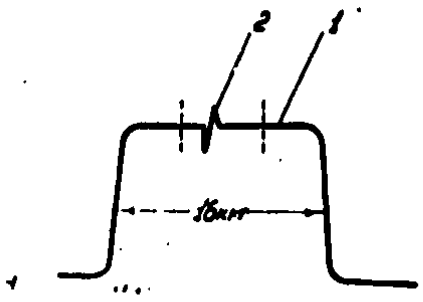


Fig.14: Display on the screen of the synchroscope CRT with the checking of the step sweep-delay:
1 - the 16 km - pulse display
2 - the pip of the 20 km- pulse display.

Set subsequently the "Range delay" switch to the following respective positions: 2, 4, 6, 8 etc...up to 30.
In all positions of the "Range delay" switch the 20 km pip should be placed within the limits of the 16 km pulse width. If this is not true, adjust the circuit of the step sweep delay by means of the potentiometers marked R 116 and R 118.

installed on the right side panel of the timer and control unit. In positions from "0" to "14" of the "Range delay" switch the adjustment is done by means of the R 116 potentiometer while in positions "16" to "30" of this switch the R 118 potentiometer should be used for adjustment of the circuit.

The adjustment should be repeated until the 20 km pip is safely placed within the limits of the inner third of the 16 km pulse display.

Prior to the above described adjustment, turn the "Range" control knob on the panel of the computing mechanism unit to shift the measurement pulse on the screen of the monitoring CRT to a position where it can be conveniently observed.

During the adjustment by means of the R 116 and R 118 potentiometers it is necessary to observe the measurement pulse and to ascertain that it is clearly visible in all positions of the "Range delay" switch.

7) In the same way check the circuits of the step sweep-delay with the equipment operating in the "Scanning" position. For this purpose set the "Range delay" switch to its respective positions from "0" to "24". In position "24" of the "Range delay" switch the brightness of the sweep traces on the screens of the monitoring CRT and the PPI tube of the radar bomb sight equipment, as well as on the screen of the synchroscope CRT, should decrease.

§ 11. <u>Inspection and adjustment of the continuous delay of the beginning of the sweep</u>.

1) Set the "Range in km" switch on the timer and control unit to position "10-60", the "Range delay" switch to position "0" and the "Calibration marking" switch to position "10 km". Turn the "Expansion 10-60" control knob in clockwise direction to its extreme position ( i.e. the 60 km range). The "Expansion of center in km" control knob on the panel of the computing mechanism unit should be set to position "0". Switch in the high voltage of the transmitter.

2) Switch in the system of antenna rotation and slightly turn the "Expansion of center in km" control knob in the vicinity of position "0" to obtain a coincidence of the transmitter pulse dis-

play with the beginning of the sweep on the screen of the plan position indicator. The indication on the "Center expansion" scale of the drum should be 0 ± 2,5 km.

3) Turn the "Expansion of center in km" control knob in anti-clockwise direction to obtain a coincidence of the first ten-kilometer range marker following after the transmitter pulse, with the beginning of the sweep line.
The indication on the "Center expansion" scale of the computing mechanism unit should be within ± 10 ± 2,5 km.
4) Turn the "Center expansion" control knob to obtain a coincidence of the second ten-kilometer range marker following after the transmitter pulse display, with the beginning of the sweep tra - ce. The indication on the "Center expansion" scale should be within + 20 ± 2,5 km.
5) In the same manner inspect the calibration of the computing mechanism unit with the -30 and +40 km delay. The tolerance in the indication of the scale of the computing mechanism unit should not exceed the limits of +2,5 km.
6) Set the "Center expansion" control knob to the position corresponding to zero delay ( the indication on the "Center expansion" scale should be approximately zero).
7) Turn the "Center expansion" control knob in clockwise direction until the first ten-kilometer range marker, following immediately after the transmitter pulse display, starts moving from the beginning of the sweep ( the transmitter pulse is placed at an indicated distance of 10 km from the beginning of the sweep). The indication on the "Center expansion" drumscale should be + 10 ± 2,5 km.
8) Set the "calibration marking"switch to position "2 km" and turn the "Center expansion" control knob in clockwise direction to its extreme position. Now further two and half of the two-kilometer circular markers ( at least) should shift from the screen center, i.e. the center expansion obtained should be at least 15 km.
9) If the tolerance of the indication in the checked points on the continuous delay scale surpasses a value of ± 2,5 km, it is necessary to calibrate the continuous delay system in the following way:

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a) Set the "Center expansion" scale to zero and turn the slider of the "Minimum center expansion" potentiometer, accessible from the side panel of the computing mechanism unit, to obtain a coincidence of the transmitter pulse display with the beginning of the sweep.

b) Set the "Center expansion" scale to position " +40 km" and turn the slider of the "Maximum center expansion" potentiometer to obtain a coincidence of the fourth 10 km circular range marker following after the transmitter pulse display with the beginning of the sweep.

c) Set the "Center expansion" scale back to "0 km" and check the coincidence of the transmitter pulse display with the beginning of the sweep. If necessary, repeat the adjustment by means of the "Minimum center expansion" potentiometer.

d) Inspect the calibration with the " +40 km" delay of the beginning of the sweep and, if necessary, repeat the adjustment of the "Maximum center expansion" potentiometer. Then repeat the calibration in the " 0 km" point, etc.

The inspection and the adjustment of the continuous delay circuit can be performed also with the disconnected transmitter, by calibrating in the " 0 km" and "40 km" points in reference to the twenty-kilometer range markers.

In this method of calibration the "Calibration marking" switch should be set to position "20 km" and the "Zero" position should be adjusted on the "Center expansion" scale. Now turn the axle of the "Minimum center expansion" potentiometer to obtain a coincidence of the next twenty-kilometer circular range marker with the beginning of the sweep.

Set the " +40 km" position on the scale and adjust the "Maximum center expansion" potentiometer to obtain a coincidence of the next twenty-kilometer circular range marker with the sweep beginning.

Further inspection should be performed as described in the above Items Nos. 1-8. Instead of the transmitter pulse display make use of the ten-kilometer pulse, corresponding to the twenty-kilometer pulse with the delay of "0 km". Prior to this set the "Calibration marking" switch to position "10 km".

## § 20. Calibration and inspection of range-indication accuracy of the computing mechanism unit.

1) Set the "Range in km" switch installed on the panel of the timer and control unit, to position " 10-60". Set the "Tube ... switch" to position "1" and the "Calibration marking" switch to position " 2 km"

2) Set the antenna rotation switch to position "Off". The "R.F. Gain" and "Expansion 10-60" control knobs turn in anti-clockwise direction to their extreme position.
Cut on the transmitter high voltage and, by turning the "Center expansion" control knob, adjust the transmitter pulse display to the beginning of the sweep on the screen of the plan position indicator CRT.

3) Turn the "Range" control knob on the computing mechanism unit, and obtain a coincidence of the measurement pulse with the first two-kilometer calibration marker following after the transmitter pulse display.
In the position in which the measurement pulse coincides with the two-kilometer pulse, the amplitude of the resultant sharply increases.
An exact coincidence should be adjusted by means of the maximum amplitude of the resulting pulse, by turning the small "Range" control knob ( to be pressed).
An approximative coincidence of the pulse is achieved by turning the great "Range" control knob. The display, obtained on the screen of the monitoring tube with the coincidence of both pulses, is shown in Fig. 15.

4) Read the indication on the lower scale of the drum of the computing mechanism unit, the indicated range should be

$$2{,}000 \text{ m} - a \pm 100 \text{ m},$$

where "a" is the constant error of the range measurement, the magnitude of which is given in the table placed on the front panel of the coupling unit of the optical bomb sight or on the unit No.8. The method of evaluation of this error is explained in Chapter IV, § 21.

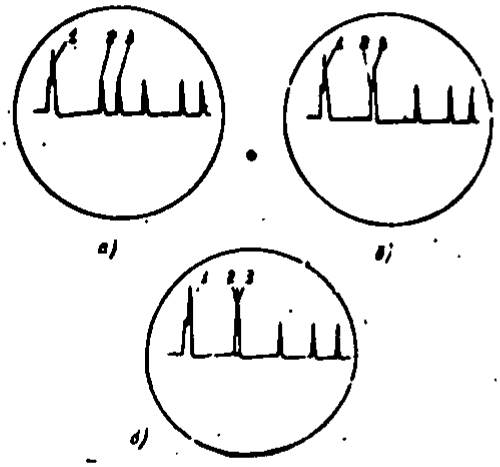



Fig. 15: Display on the screen of the monitoring tube with the coincidence of the measurement and calibration pulses:
upper left- the pulses do not coincide
upper right- beginning of the coincidence of the pulses
lower - coincidence of the pulses
1 - the transmitter pulse
2 - the measurement pulse
3 - the two-kilometer calibration pulse

5) Set the "Calibration marking" switch to position " 10 km" and by turning the " Center expansion" control knob, adjust the third ten-kilometer pulse following after the transmitter pulse display, in the left part of the sweep trace on the monitoring tube screen.

6) Turn the "Range" control knob on the computing mechanism to obtain the coincidence of the measuring pulse with the third ten-kilometer pulse following after the transmitter pulse. The indication on the drum-scale of the computing mechanism unit should be 30,000 m - a $\pm$ 200 m.

7) If other indications are obtained on the scale of the computing mechanism than the above given ( i.e. "2,000 m - a $\pm$ 100 m", and "30,000 m - a $\pm$ 200 m"), the computing mechanism unit should be calibrated in the following manner:

a) Adjust a range of "2 km -a" on the scale of the computing mechanism unit, and turn the "Center expansion" control knob until the transmitter pulse and the measurement pulse appear in the left part of the sweep trace on the monitoring tube screen.

b) Set the "Calibration marking" switch to position " 2 km" and turn the slide of the "Minimum range" potentiometer, installed on the side panel of the computing mechanism unit. Adjust the coincidence of the measurement pulse with the first two-kilometer calibration pulse following after the transmitter pulse display.

c) Adjust the range of "28 km-a" on the scale of the computing mechanism, and set the "Calibration marking" switch to position " 10 km". Turn the "Center expansion" control knob until the third ten-kilometer pulse following after the transmitter pulse is shifted approximately to the center of the sweep on the screen of the monitoring tube. Ahead of this pulse the measurement pulse should be visible. Set the "Calibration marking" switch from position " 10 km" to position " 2 km" and back, and observe the position of the two-kilometer pulse on the screen of the monitoring tube ( the pulse ahead of the third ten-kilometer pulse, i.e. the 14 th two-kilometer pulse, if counted from the transmitter pulse).

d) Set the "Calibration marking" switch to position " 2 km" and turn the slide of the "Maximum range" potentiometer to obtain the coincidence of the measurement pulse with the 14 th two-kilometer pulse after the transmitter pulse.

e) Inspect the coincidence of the pulses in the "2 km-a" range and, if necessary, repeat the calibartion. After this inspect the calibration in the " 28 km-a" range and repeat the calibration, it necessary.

8) Check the accurancy of the performance of the computing mechanism unit. For this adjust the coincidence of the measurement pulse with the second, third, fourth, fifth etc. two-kilometer calibartion pulses up to the fifteenth ( counted from the transmitter pulse). Inspect the range indication on the scale of the computing mechanism drum.

During this inspection turn the "Center expansion" control knob and set it so that the measurement pulse and the respective two-kilometer calibration pulse be placed in the left part of the sweep trace on the monitoring tube in their coincidence position.

Now evaluate the error in range measurement of the computing mechanism unit from the following formula:

$$= 2{,}000\ n - a - r,$$

where: $\Delta$ = the error in the range measurement, n = number of the two-kilometer pulse which coincides with the measurement pulse, a = the constant error in the range measurement , r = the range read from the computing mechanism unit.

The error of the range measurement should not exceed:

in the range from 2 to 14 km.....$\pm$ 100 m

in the range from 16 to 30 km.....$\pm$ 200 m.

9) Examine the accurancy of the computing mechanism unit performance with the A-C. voltage variations from 112 to 118 V.

The error of the range measurement should not exceed the admissible value ( as per Item 8) even in this case.

If the error in some checking points exceeds the admissible value, it may be decreased by means of the "Maximum range" and "Minimum range" potentiometers, however, this adjustment causes an increase of the error in some other points. However this error need not exceed the admissible limits in any point of the measured range. The supplementary calibration is performed by means of the "Minimum range" and "Maximum range" potentiometers in the ranges of up to 14 km and above 16 km, respectively.

## § 13. Inspection and adjustment of the position of the longitudinal and course markers.

The methods described in this paragraph, used in the inspection and adjustment of the course marker should be applied only with the inspection of the radar bomb sight equipment on the stand. An accurate adjustment of the position of the course marker is performed after the installation of the radar bomb sight equipment aboard the aircraft ( see Chapter I, § 4).

The inspection should be performed in the following order:

1) [illegible] "Range delay" switch to position "0", the [illegible] tch to position "10-60" and the switch on the azimuth [illegible] zation unit to position "Optical bomb sight". The "Sec- [illegible] an- continuous rotation" switch on the control panel of [illegible] otor scanning should be set to position "Sector", the [illegible] Fast" switch to position "Fast".

2) [illegible] the antenna rotation system and adjust the switches of the [illegible] otor scanning unit for scanning of the front sector. On [illegible] screen of the plan position indicator a longitudinal [illegible] should appear, pointed to the zero reference of the azi- [illegible] scale with an accurancy of ± 1°. If this longitudinal [illegible] is pointing in a different direction, the screws of the [illegible] ction coil of the CRT should by partly loosened and while [illegible] ng the screws, the deflection coil of the plan position [illegible] ator tube should be turned so that the longitudinal mar- ker points towards the zero reference of the azimuth scale. Af- [illegible] wards the screws of the deflection coils should be tigh- [illegible] l.

3) [illegible] the "R.f.gain" control knob in clock-wise direction to its [illegible] me position. By means of the "Receiver tuning" control [illegible] the maximum noise level on the screen of the monitoring [illegible] should be adjusted. The longitudinal marker on the screen of the plan position indicator should be always perfectly vis- [illegible] le to enable reading.

[illegible] adjustment should be performed by means of the R1-133 po- [illegible] tiometer installed on the right side panel of the chassis [illegible] the PPI unit.

4) [illegible] the switch on the azimuth stabilization unit to position [illegible] lsyn zero". On the screen of the plan position indicator [illegible] a vertical course marker should be visible. The width of [illegible] course marker should not exceed 1,5°, and the darkened [illegible] tor after the course marker should not be greater than 3°.

5) [illegible] the switch situated on the azimuth stabilization unit to [illegible] ition "Compass". Cut off the antenna rotation system and [illegible] n the antenna manually to such a position in which the cam [illegible] the base of the main gear drive of the antenna presses the [illegible] niature course marker contact. Turn the selsyn transmitter [illegible] the compass, type PIK-45 in such a way that the course of [illegible] is indicated on the compass card scale.

After the azimuth stabilization system compensates for the deviation, the sweep on the screen of the plan position indicator tube should point towards the zero reference of the azimuth scale with an error of not ever $\pm 2^{\circ}$.

If the sweep does not point in the correct position, the following measures should be taken:

a) Lift the gear with the spring inlay, coupling the main gear drive and the azimuth differentiating system.

b) Turn the shaft of the azimuth differentiating system so that the sweep trace points towards the zero reference of the azimuth scale.

c) Install the removed gear of the azimuth differentiating system to its place; the higher part of the gear should be turned by 1-3 teeth in reference to its lower part in the direction opposite to that of the spring pressure, to assure a reliable coupling.

6) Set the switch on the azimuth stabilization unit to position "Solsyn zero". The sweep trace should point towards the zero reference of the azimuth scale with an accurancy of $\pm 1^{\circ}$. The antenna should be in the position in which the miniature marker contact is closed. If the sweep is not in the correct position, the following is necessary:

a) Loosen partly the screw locking the "Zero adjustment" sector on the azimuth stabilization unit.

b) Turn the sector for adjusting the sweep trace to the zero reference of the azimuth scale of the plan position indicator screen. If the correct position of the sweep trace cannot be adjusted by rotation of the sector, the sector should be removed from the zero.solsyn shaft and the shaft should be turned to bring the sweep to the zero position. Then the sector is mounted to its place and the screws are tightened.

7) Inspect the brightness of the course marker and, if necessary, adjust it by turning the "Course marker brightness" potentiometer.

8) Inspection and regulation of the antenna system rotation velocity.

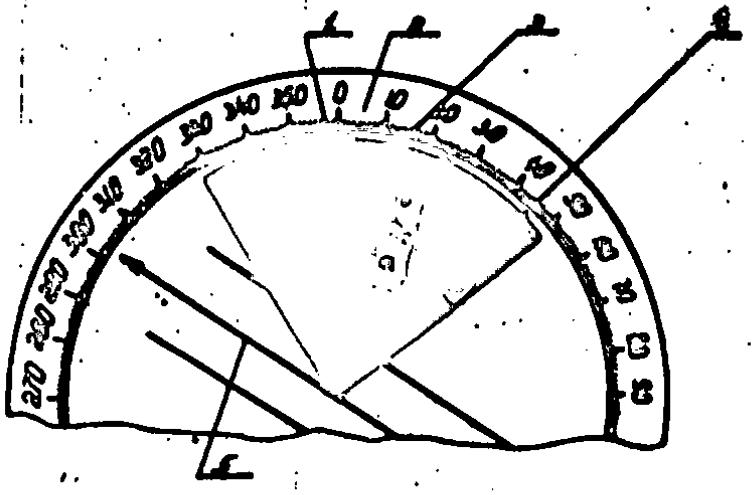
1) the switch on the sector-scanning control panel to position ntinuous rotation" and set the "Slow-Fast" switch on the pa-

e timer and control unit to position "Slow".
) the antenna rotation mechanism and examine the rotation
:eep trace onnthe plan position indicator screen in clock-
)ction.
)p-watch and observe the rotation of the sweep on the
ition indicator screen to find the rotation velocity of
nna system. The rotation velocity should be from 9 to 17

)otation velocity is off the above given limits, the
'g is necessary:
)t the D.C. voltage of the power-supply to exactly 27 V.
)en the three screws and remove the cover from the an-
n case ( Unit No.15).
'en partly the screw of the yoke of the R 1501 variable
)stor.
)t the yoke of this resistor to obtain a rotation velocity
- 13 r.p.m.
)ten the screw of the yoke and replace the cover onto the
)nna case.
e "Slow-Fast" switch on the panel of the timer and control
o position "Fast" and check the rotation velocity of the
a; it should be now within the limits of 19 and 29 r.p.m.

)pection and adjustment of the antenna with sector scanning.

e"sector scan-Continuous rotation" switch on the control
of the sector scanning unit to position "Sector- scan".
ans of the sector switches set the front sector scanning.
)witch of the antenna rotation mechanism should be set to
)ion "Fast".
he switch on the azimuth stabilization unit to position
cal bomb sight".
e screen of the plan position indicator unit a longitudinal
)r should be presented. By means of the cursor line on the
)r of the plan position indicator the angle of the front
)r should be measured now ( at least 60°); the darkened sec-
is not considered in this measurement.
)idth of the darkened sector at the end of the front sector
should not exceed 20° ( see Fig.16).




16 : Display on the plan position indicator screen during the inspection of the front sector

1 - the longitudinal marker
2 - the azimuth scale
3 - the center of the front sector
4 - the darkened sector
5 - the cursor line of the filter

e angle of the darkened sector with the operation in the "Op- cal bomb sight" position should be preferably measured with e continuous rotation of the antenna.

3) spect the position of the center of the front sector relative the longitudinal marker. For this measurement the $\lambda_1$ and $\lambda_2$ gles should be measured ( see Fig.16) and the angle between e longitudinal marker and the center of the fore sector should evaluated from

$$\gamma = \frac{\lambda_1 - \lambda_2}{2}$$

ere $\lambda_1$ = the angle between the longitudinal marker and the left limit of the front sector,

$\lambda_2$ = the angle between the longitudinal market and the right limit of the front sector

$\gamma$ = the angle between the longitudinal marker and the center of the front sector.

angle between the longitudinal marker and the center of front sector should be not more than 5°. 50X1-HUM
his angle is greater, the following measures should be ta-

ut off the antenna rotation mechanism and loosen the four holding the cover of the key switch of the sector scanning on the azimuth differentiating mechanism unit, and remove the cover.

Loosen slightly ( approximately by 180°) with a spanner the two 6 mm screws locking the key, so that the key turns in relation to the shaft if a small pressure is applied.

Cut on the antenna rotation mechanism and inspect the scanning of the antenna cut is effected in the front sector. If the antenna rotates continuously in a circle in position "Sector scan" of the "Sector scan-Continuous rotation" switch, tighten slightly the screws locking the key of the sector scanning.

Inspect the position of the center of the front sector in relation to the longitudinal marker and measure the angle between the center and this marker.

Install the cursor to the left limit of the front sector and cut on the antenna scanning system.

Turn the key switch of the sector scanning appromimately by an angle equal to the ' angle, however in opposite direction ( in relation to ' ). Thus, for example, if the center of the scanning is placed 8 degrees to the right of the longitudinal marker, the key should be turned approximately by 8° in anti-clock-wise direction.

) Switch in the antenna scanning mechanism and inspect the position of the left limit of the front sector in relation to the cursor line. The angle between them should be equal to the required angle of the shift to the center of the front sector. If this angle is too small or too great, the antenna scanning mechanism should be switched off and the key should be turned in the respective direction.

) Tighten the screws locking the key of the sector scanning and inspect the position of the center of the front sector relative to the longitudinal marker.

The angle between them should not exceed $\pm 5^{\circ}$. If the angle is greater, repeat the adjustment according to points b., c., d., e, f., and g. When tightening the screws the operating key should not be pressed too strongly to the contact pad, as this could influance unfavourably the performance of the sector scanning system.

4) Set the switch on the azimuth stabilization unit to position "Selsyn zero".
Set the "Sector scan-Continuous rotation" switch to position " "Sector scan", and the "Slow-Fast" switch to position "Fast". the sector switch set to front sector position. Cut on the antenna rotation system and turn simultaneously both sector switches to inspect the operation of the antenna scanning through all azimuth positions.
The width of the sectors next to the left and right limits of the front sector, may be smaller by $10\text{-}15^{\circ}$ as compared with the front sector; the angle of the other sectors should be from 60 to $85^{\circ}$. With fast scanning the overlapping of the sectors should be at least $1,5^{\circ}$.
With slow scanning the sector angle should be $50\text{-}70^{\circ}$. The uncovered angle between the sectors should not exceed $2^{\circ}$.

5) By means of the sector switch adjust the angle of the back sector of $60^{\circ}$ and inspect the scanning speed of the antenna which should be:
With fast scanning ..... 70 - 120 scans/min.
With slow scanning.....50 - 80 scans/min.

6) Cut off the antenna rotation system.

§ 16. Inspection and adjustment of the antenna tilt mechanism on the stand.

A. Inspection of the antenna tilt angle.

1) By means of two levels, installed on the antenna base at an angle of $90^{\circ}$, adjust the exact horizontal position of the antenna assembly base.

2). Install a protractor on the antenna segment and press the "Up Down" switch to adjust the antenna to a position where the angle between the segment and the horizontal plane is $\beta^{\circ}$ ( see Fig.17)

N o t e : The angle of $\beta^{\circ}$ corresponds to the position of the antenna in which the radiation maximum is parallel to the horizontal plane. This angle is checked simultaneously with the measurement of the horizontal radiation pattern of the antenna (§30). The individual value of this angle is given in the papers of the radar bomb sight equipment; usually this nagle is from 6 to 8°.

The antenna tilt indicator should give a tilt-angle of $0 \pm 2^{\circ}$.

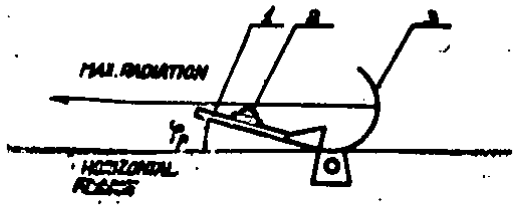



Fig.17: Position of the radar bomb sight antenna in the adjustment of the zero antenna tilt:
1 - the segment of the antenna
2 - the protractor
3 - the antenna reflector
Upper plane marked in the picture- maximum radiation plane
Lower plane in the picture- the horizontal plane.

3) Check the antenna tilt variation while pressing the "Up-Down" switch in its position "Up" until the antenna arrives to its extreme upper position ( if the measurement is done on the stand in the repair shop, the antenna segment will tilt downwards). Read the tilt-angle of the antenna from the protractor, i.e. the angle between the antenna segment and the horizontal plane ($\beta_u$).

late the angle of the upwards tilt of the antenna from ormula

$$\alpha_1 = \alpha_o - \alpha_u,$$

$\alpha_1$ is the angle of the upwards antenna-tilt,
$\alpha_o$ is the angle measured with the protractor in the initial position of the antenna
$\alpha_u$ is the angle measured with the protractor in the extreme upper position of the antenna.

angle of the upwards antenna - tilt should be at least $5^0$.

ject the angle of the downwards antenna-tilt by pressing the "Down" switch in its lower position until the antenna stops ts extreme lower position. Find from the protractor the en- of the antenna tilt in relation to the horizontal plane ). Calculate the downwards antenna-tilt from the formula

$$\alpha_2 = \alpha_d - \alpha_o$$

e $\alpha_2$ is the angle of the downwards antenna tilt,
$\alpha_d$ is rhe angle measured with the protractor in the extreme lower position of the antenna
$\alpha_o$ is the angle measured with the protractor in the initial position of the antenna

angle of the downwards antenna-tilt should be at least $20^0$.

stment of the antenna tilt.

ny of the above mentioned angles is smaller than required, tenna tilt mechanism should be adjusted. If the sum of both is less than $25^0$, the adjustment should be done by means of re switches Mk 1502 and Mk 1503, installed in the antenna Unit No.15).

the sum of both angles is equal to $25^0$, or greater, and one antenna-tilt angles is too small, the adjustment should be changing the length of the pull rod controlling the antenna

Example No.1. If the downwards tilt-angle of the antenna is under 20°, the upwards tilt-angle is 5° and the sum of both angles is under 25°, the adjustment is done with the miniature switch Mk 1503, installed in the antenna box ( left side, down). The adjustment is done as follows:

a) remove the cover from the antenna box.
b) Loosen the lock-nut onnthe screw pressing the switch ( use the 8 mm spanner).
c) Loosen slightly the screw and check with the protractor the downwards antenna-tilt angle. If this angle is 20° or less, loosen the screw sligthly more and repeat this operation until the 20° the antenna tilt angle is obtained.

Example No.2: If the downwards tilt angle of the antenna is 20°, and the upwards tilt angle is less than 5°, the adjustment is to be done with the Mk 1502 miniature switch, installed in the antenna box ( left side up). The screws are accessible through an opening in the lower part of the antenna box.

Example No.3: If the upwards tilt angle of the antenna is less than 5° , and the downwards antenna tilt angle is more than 20° , and if the sum of the angles is more than 25°, the adjustment should be done by changing the length of the pull rod tilting the antenna:

a) Loosen partly, by means of the 9 mm spanner, the nut on the threaded part of the pull rod.
b) Remove from the cam the splint pin fastening the pull rod to the antenna.
c) Remove the cam and loooson the pull rod.
d) Increase the length of the pull rod by turning off its threaded part.
e) Install the pull rod and the cam to their places and check the variation of the tilt angles. If necessary, repeat the changing of the length of the pull rod as explained above.
f) Install the splint pin and tighten the lock-nut.

Example No.4: If the upwards tilt angle of the antenna is more than 5°, and the downwards tilt angle is less than 20° with the sum of the angles exceeding 25° , the lenght of the pull rod has to be decreased.

ction and adjustment of the antenna tilt indicator.

t, with the protractor attached to the antenna segment, the
t angle of the antenna ( see §16 4, Item 1).
pointer of the antenna tilt indicator on the timer and con-
unit panel should indicate an angle of 0 ± 2°. If the
ter position is outside the above limits, it should be ad-
ed by means of the potentiometer controlling the antenna
( Unit No.19). This is done in the following way:
pen the Šr-19-35 connector, loosen two bolts and remove the
over of the antenna tilt potentiometer. Then connect the
bove connector to the antenna tilt potentiometer.
ut off the power-supply of the radar bomb sight equipment
nd slightly loosen ( approximately by 180° ) the screw, lock-
ng the position of the slide of the antenna tilt potentiome-
er.
urn the axle of the tilt potentiometer by an angle approxima-
ely three times as great as the angle read from the tilt po-
tentiometer. Turn it in the direction corresponding to that
n which the pointer of the indicator is deflecting from the
eference zero.
:: The pointer of the tilt indicator indicates an angle of
n instead of the zero angle. Under such conditions the slide
potentiometer should be turned by approximately 12° in clock-
irection.
ress with the index finger of the left hand the gear instal-
led on the axle of the tilt potentiometer, and with the left
hand thumbpress the slider of the tilt potentiometer, and
tighten with the right hand the screw locking the tilt poten-
tiometer in its correct position.
Cut on the power-supply of the radar bomb sight and check the
position of thepointer on the antenna tilt indicator. If the
pointer indicates an angle different from zero, repeat the ad-
justment as explained above ( Items b, c, d, ).
Replace the cover of the antenna tilt potentiometer.
st antenna downwards by an angle of 20° ± ' ( by means of
protractor). The antenna tilt indicator should indicate an
e of 20 ± 2°.

is is not so, turn the R 1902 potentiometer to obtain the
ct indication of the meter.
ct the accuracy of indication of the antenna tilt indica-
Use the protractor to change the antenna tilt angle in
of $5^{\circ}$ in the upward and downward direction, and in each
on write down the indications of the protractor and the
nna tilt indicator.
error of the antenna tilt position is checked from the fol-
ng formulae:

$$= \quad - \quad _{0} \quad - \quad _{1}$$ ( measurement of the downwards tilt angle).

$$= \quad _{0} \quad - \quad - \quad _{1}$$ ( measurement of the upwards tilt angle)

e: = measurement error ( in degrees)
= the angle read from the protractor with the initial position of the antenna of $0^{\circ}$ ( in degrees).
= the angle of the antenna tilt with reference to the horizontal plane, measured with the protractor ( in degrees).
$_{1}$ = the angle of the antenna tilt, measured with the antenna-tilt indicator installed on the timer and control unit ( in degrees).

error in the indication of the antenna tilt angle, as indied by the indicator, should not exceed $\pm 2^{\circ}$ in all points pected.

pection of the rate of change of the antenna tilt angle.

ss the "Up-Down" switch and install the antenna to the upper reme position,, and then to the down ( lower) extreme position.
both positions note the indication of the protractor.
ss the "Up-Down" switch and start the stop-watch at the same me.
ad, from the stop-watch, the time necessary for movement of the tenna from one extreme position to the other.

4) C ,ate the rate of change of the antenna tilt angle from the fo ,ing formula:

$$\omega = \frac{\varphi_1 - \varphi_2}{t}$$

where $\omega$ = rate of change of the antenna tilt ,
$\varphi_2$ = the angle, measured with the protector and corresponding to the extreme lower position of the antenna.
$\varphi_1$ = the angle, measured with the protractor and corresponding to the extreme upper position of the antenna
t = the time, measured with the stop-watch, corresponding to the movement of the antenna from its one extreme position to the other.

The rate of change of the antenna tilt angle ( $\omega$ ) should be at least 4 degrees / sec., but not over 6 degrees/sec.

E. Inspection of the operation of the antenna tilt mechanism on the aircraft.

On the aircraft, the following characteristics may be measured:

1) The limits of the antenna tilt angle, by measuring the extreme position angles with a protractor. The difference angle between the two extreme positions of the antenna defines the limits of the change of the antenna tilt which should be 25° at least. The protractor should be installed on the cover of the antenna segment.
2) The rate of change of the antenna tilt angle, as described above. ( §16, D.).
3) The performance of the antenna tilt indicator. This is measured in the following way:
   a) Press the "Up-Down" switch and set the antenna to its extreme upper position. The antenna tilt indicator should indicate an angle of approximatively 5 to 10 degrees.
   b) Install the antenna in its extreme lower position. The indication should now be at least 18°.
   c) Add the values of the angles measured under "a" and "b"; the sum of the angles should be at least 21° ( usually this sum is from 25 to 28°).

pection of the accurancy of coincidence of the sweep trace with the antenna rotation.

re a calibrated chart in the following way:
ke a millimeter-paper of approximately 1,5 x 72 cm and
nd it around the base of the main gear of the antenna sys-
m so that both ends of the chart exactly meet; the rest
the paper should be cut off.
move the paper band from the gear, divide it into 12 sec-
ons, and draw the respective dividing markers with a pen-
l; each section is equal to 30°.
ll, on one of the bolts ( the extreme right one) on the
na box ( Unit No.13), a visor device ( see drawing No.32-
0-04).
the "Range in km" switch on the timer and control unit pa-
to its position " 10-60", the "Calibration marking" switch
osition " 10 km", and the switch on the azimuth stabiliza-
unit to position "Selsyn zero". By means of the " Expansion
" control adjust a sweep ratio of 30 to 60 km. Use the
eep amplitude" potentiometer for adjustment of a sweep am-
ude equal to the radius of the PPI screen.
on the power-supply of the radar bomb sight equipment and
manually the antenna so that the sweep trace points in
direction of zero reference mark on the azimuth scale. For
, install the cursor line to the zero reference of the azi-
scale and obtain the coincidence of the medium part of the
p trace with the cursor.
the degree- calibrated chart to the antenna gear in a po-
on where one of the reference marks on the chart coincides
the position ofthe pointer of the visor device. This point
be further considered as zero reference.
manually the antenna in steps of 30° ) the angle is to
read from the calibrated scale on the antenna gear). Note
angles of antenna scanning deflection on the azimuth scale
the plan position indicator ( shift the cursor line to coin-
e with the medium part of the sweep trace). Every time wri-
down the difference between the sweep trace angle from the
enna azimuth angle.

e antenna azimuth angle is 30° and the corre50X1-HUM
e on the plan position indicator screen is 32°. The dif-
twen both angles is thus 2°.
um admissible difference between the above two angles is

h position of the antenna evaluate the curvature of the
line from the center of the PPI screen to its circumfer-
the following way:
int the cursor of the filter on the plan position indica-
r screen to the calibration markers situated in the be-
nning and the center of the sweep trace. The position of
e cursor line is to be noted from the azimuth scale of the
I screen.
rn the cursor of the filter to the calibration markers in
e center and the end of the sweep trace. The position of
e cursor line is to be noted from the azimuth scale of the
PI screen.
alculate the curvature of the sweep trace as the difference
etween the two results obtained with the measurement des-
ribed in " a" and "b". The curvature should not exceed 3°.
ulate the mean quadratic error from the following formula:

$$\text{mean} = \sqrt{\frac{(\Delta_0)^2 + (\Delta_{30})^2 + (\Delta_{60})^2 + \ldots + (\Delta_{330})^2}{12}}$$

re: $\text{mean}$ = the mean quadratic error

$\Delta_0, \Delta_{30}, \Delta_{60}, \ldots \Delta_{330}$ = the respective differences between the angle of the sweep trace and the antenna angle, as measured with the position of the antenna in the respective angles of 0°, 30°, 60°..330°

The mean quadratic value should not surpass 1,5°.

Inspection of the rate of change of bearing of the compass selsyn-transmitter, type PDK-45, in the azimuth stabilization unit.

t the "Range in km" switch on the timer and control unit to
sition "100" and the switch on the azimuth stabilization unit
position "Selsyn zero".

2) [illegible] "Left-Right" button on the timer and control unit, and [illegible] antenna to a position in which the sweep trace of the [illegible] ition indicator points to the zero reference of the azi- [illegible] le. Set to this position also the cursor line of the filter.

3) Set [illegible] switch on the azimuth stabilization unit to position "Ca[illegible]" and use a permanent magnet to deflect the moving system of the PKD-45 selsyn transmitter so that the sweep trace is [illegible] to the same position as in the "Selsyn zero" position of [illegible] switch. Note, from the scale of the selsyn-transmitter, the [illegible] ition of the compass card ( approximately 0°).

4) By [illegible] of the permanent magnet turn the moving system of the selsyn transmitter by 90° in arbitrary direction from the position measured according to Item 3 of this paragraph. After the system of the azimuth stabilization compensates for the deflection, the sweep trace on the plan position indicator turns approximately by the same angle and in the same direction.

5) Set the switch on the azimuth stabilization unit to position "Selsyn zero" and start the stop watch in the same moment. The sweep on the plan position indicator will start turning. In the moment of the stop of the sweep, switch off the stop-watch.

6) Calculate the rate of change of bearing of the compass selsyn-transmitter in the azimuth stabilization unit from the following formula:

$$\omega = \frac{\alpha}{t}$$

where $\omega$ = the rate of change ( degrees per sec).

$\alpha$ = the angle compensated by the compass selsyn-transmitter ( 90 $\pm$ 1°).

t = the time measured with the stop-watch ( in seconds).

The rate of change of bearing of the compass selsyn-transmitter in the azimuth stabilization unit should be at least 4,5 degrees per second.

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6 pection of the coincidence of the sweep trace with the movement of the compass.

1) Set the "range in km" switch on the timer and control unit to position "100". The switch on the azimuth stabilization unit should be set to position "Compass".
2) Use a permanent magnet for adjusting the compass card to position 0°, and turn the antenna so that the cam on the main gear of the antenna assembly presses the miniature switch of the course marker.
The sweep trace on the plan position indicator screen should now be pointing in the direction of the zero reference of the azimuth scale with a tolerance of ± 2°. If this is not true, adjust the system, as described in § 13, Item 5. Write down the value of the deflection of the sweep trace from the zero reference of the azimuth scale.
3) Use a permanent magnet to deflect the compass card of the selsyn transmitter in successive steps of 30°, and read the angles of the sweep deflection on the screen of the plan position indicator. In each of the inspected bearings write down the error observed ( i.e. the difference between the angle of deflection of the compass and the angle of deflection of the sweep on the plan position indicator).
The maximum admissible error is ±4°.
4) Calculate the mean quadratic error from the following formula:

$$\Delta_{mean} = \sqrt{\frac{(\Delta_0)^2 + (\Delta_{30})^2 + (\Delta_{60})^2 + \ldots + (\Delta_{330})^2}{12}}$$

where: $\Delta_{mean}$ = mean quadratic error
$\Delta_0, \Delta_{30}, \Delta_{60} \ldots \Delta_{330}$ = the respective errors with measurements in the 30°, 60°....330° bearing.
The mean quadratic error should not exceed the angle of 2°.

C Inspection of the peak voltage of the trigger pulse, produced by the range unit.

The measurement of the peak voltage of the firing pulse may be performed with any of the instruments used for measurement of peak

voltage: the 251 synchroscope, the VIK -1 and VIK-2 p50X1-HUM, meters, the VKS-7B voltmeter, the 261 pulse generator, etc.

Further on, the measurement methods used with some of the mentioned instruments are described. The measurement is performed at the end of the "44" cable which should be disconnected from the transmitter.

The measurement should be done in the following three regimes of operation of the radar bomb sight equipment:

1) The "Beacon-Scanning" switch in position "Scanning", the "Range in km" switch in position " 10-60".
2) The "Beacon -Scanning" switch in position "Scanning", the "Range in km" switch in position "100".
3) The "Beacon-Scanning" switch in position "Beacon" , the "Range in km" in position "100".

The peak voltage of the trigger pulse of the transmitter should be at least 105 V in all the three mentioned regimes of operation.

The voltage measured is usually within the limits of 130 to 170 V. The high voltage of the transmitter should be switched off during the measurement of the trigger pulse peak voltage.

A. Measurement of the peak value of the transmitter trigger pulse voltage with the synchroscope, type 251.

1) Connect the power-supply cable of the synchroscope to the 220V 50 c.p.s. or 115V 400 c.p.s. mains ( the receptacles on the power convertor control panel). Prior to switching in the power supply inspect the correct position of the voltage switch ( on back side panel of the synchroscope box) according to the voltage used.
2) Set the switches on the synchroscope panel in the following positions: "Input resistance and attenuation" to position "1 : 100", "Sweep " to position "Waiting" , "Time Ranges" to position "10 microseconds", "Time calibration" to position "Off", "Amplitude calibration" to position "Off", "Synchronization control: Internal/External" to position "Internal", "Synchronization control + or -" to position "-".
3) Disconnect the cable "44" from the Šr-11-44 receptacle on the transmitter and attach it to the left "Input" respectacle of the synvhroscope.

he "Brightness" control knob of the synchroscope in clock-
irection and adjust the adequate brightness of the display
) scree, By means of the " X axis Left-Right " and " Y axis
m" controls adjust the display in the center of the screen.
he "Focus" control to focus the display on the screen. If
rizontal sweep is obtained, turn the "Gain" control knob
er right) to obtain a stable display on the screen of syn-
cope.
he "Attenuation" and "Continuous" control knobs for adjust-
of the pulse height on the screen of the synchroscope equal
or 6 calibration divisions.
the lower "Gain" control knob in clockwise direction to its
me position and set the "Amplitude calibration" switch to
tion "On".
the "Voltage" control knob until the height of the vertical
e, obtained on the screen, is equal to that adjustment ac-
ing to Item 5 of this paragraphe.
, from the scale of the voltmeter installed on the front p
of the synchroscope, the value of the supplied calibrated
ge and multiply it by two. The value obtained is equal to
peak value of the transmitter trigger pulse voltage,
orm the above described measurement in all three regimes of
ation of the radar bomb sight.

urement of the peak value of the trigger pulse of the
nsmitter with the VIK-1 pulse voltmeter.

witch in the power-supply cable of the VIK-1 meter to the
220V 50 c.p.s. or the 115 V 400 c.p.s. mains ( receptacles
on the control panel of the power convertor unit). Prior to
switching on the power source, inspect the correct position
of the voltage s itch.
Lift the upper cover of the pulse voltmeter and install the
special connector from the accessory equipment of the VIK-1
nto the central receptacle.
Set the switch on the front panel of the voltmeter to position
"300V" and connect the receptacle "3" on the front panel with
the connector installed in the central receptacle on the up-
per panel of the voltmeter.

he power supply switch on the front panel of the voltmeter to position "On". After the tubes are sufficiently heated ) minutes) turn the "Zero adjustment" control knob on the panel of the voltmeter to install the pointer of the meter to zero position.

5) Disconnect the conductor from the connector, installed in the central receptacle. Connect the receptacle "Z" on the front panel of the voltmeter with the chassis of the radar bomb sight equipment.

6) Disconnect the cable "44" from the Šr-11-44 receptacle of the transmitter and insert it in the connector, installed in the central receptacle of the voltmeter.

7) Read the peak voltage of the trigger pulse of the transmitter on the scale of the meter.

8) Repeat the measurement in the further two regimes of operation of the radar bomb equipment.

6. Measurement of the peak voltage of the transmitter trigger pulse with valve voltmeter types VKS-7A and VKS/7B.

1) Connect the power-supply cable of the voltmeter to the 220 V 50 c.p.s. or 115V 400 c.p.s. power mains.

2) Set the switch of the measurement range of the instrument to position "150".

3) Insert a metal connector into the "V" and "Z" receptacles on the front panel of the voltmeter and turn the "Zero adjustment" control knobs to adjust the pointer of the meter to Zero.

4) Disconnect the connector from the "V" and "Z" receptacles and connect the "Z" receptacle with the chassis of the radar bomb sight equipment.

5) Disconnect the cable "44" from the Šr-11-44 receptacle of the transmitter and connect this cable to the "V" receptacle of the voltmeter.

6) Read the indicated voltage from the scale of the voltmeter, and multiply it by 1,41. The obtained value is the peak voltage of the transmitter trigger pulse.

6 Inspection of the constant error in the range measurement.

The constant error in the range measurement or the constant delay, the "a" value, is caused by the delay of the radiated and received pulse in the transmitter and receiver circuits in reference to the pulse firing the transmitter and starting the operation of the range measurement system.

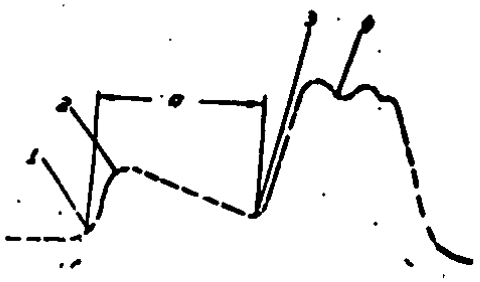
The constant error of the range measurement is taken into account with the calibration of the range of the computing mechanism and themcoupling unit of the optical bomb sight.

The inspection of the constant error in the range measurement is performed with the 251 synchroscope in the following order:

1) Switch off the power supply of the radar bomb sight and remove the cover of the timer and control unit.
2) Connect the power supply cable of the synchroscope to the 220 V 50 c.p.s. or 115 V 400 c.p.s. mains and set the switch on the back panel of the synchroscope to the respective position corresponding to the supplied voltage.
3) Connect the cathode pin ( pin No.5) of the L 208 (6P9) tube of the receiver with the left receptacle ( "Input") , i.e. the input of the examined synchroscope signal. Further connect the pin No.4 of the L 416 ( 6N8S) tube in the range unit with the right side receptacle "Input" ( i.e. input of the synchronization signal of the synchroscope. The "chassis" receptacle of the synchroscope should be connected with the chassis of the radar bomb sight equipment.
4) Set the switches on the synchroscope panel to their respective position: "Attenuation" to position "1:2", "Input resistance and attenuation" to position " 1:100", "Sweep" to position "Waiting", "Time Ranges" to position "2 microseconds", "Lenght calibration" to position "Off", "Amplitude calibration" to position "Off", "Synchronisation control: Internal-External" to position "External", "Synchronization control + or - " to position "-".
5) Set the switches on the timer and control unit of the radar bomb sight equipment to their following positions: "Range delay 10 km" to position "0", "Range in km" to position "10-60", "Detector front-Power supply check" to position "Power supply check" , "Antenna control On-Off" to position "Off", "Tube switch " to position "1". "Calibration marking" to position "2 km", and

ation- Calibration" to position "Operation". 50X1-HUM
R.f.gain" control knob should be turned in anti-clockwise
ition to its extreme position, the "Expansion of the center
" handle on the computing mechanism unit set to zero.

6) the "Power convertor On-Off", the "Mains 26 V-115V" and the "Transmitter heating" switches to their positions "On". After five minutes switch in the high voltage of the transmitter.
7) Switch in the power-supply ( The "Brightness") control knob of the synchroscope and turn the right lower "Gain" control knob of the synchroscope until the sweep trace is visible on its screen.
8) Turn the "Expansion of the center in km" control knob on the computing mechanism unit to the vicinity of the zero reference, until the two-kilometer calibration pulse is visible on the screen of the synchroscope CRT near to the transmitter pulse display.
9) Turn the "Input signal control" ("Continuous") and "Attenuation" control knobs to obtain a pulse height on the synchroscope screen of 4 -5 divisions.
If the display on the screen is not stable, turn the right "Gain" control to suppress any instability in the display.
10) Set the "Length calibration" switch on the synchroscope to position "On" and decrease the brightness of the display to such a degree that the calibration markers are clearly visible. The display, obtained with the measurement, is presented in Fig.18.



18. - Display on the screen of the synchroscope with the evaluation of the constant error ("a") in the range measurement:
1- leading edge of the two-kilometer range pulse
2- two-kilometer range pulse
3- leading edge of the transmitter pulse
4- transmitter pulse

the calibration markers contained between the respective ing edges of the two-kilometr range pulse and the transmitter pulse. The distance between the neighbouring calibration markers is 15 m.

The distance between the transmitter pulse and the next two-kilometer pulse i.e. the constant error, should not exceed 250 m.

The value of the constant error "a" obtained in the measurement, should be written down in the small table placed on the coupling unit of the optical bomb sight, or on the computing mechanism unit in equipment of series Nos. 101 and up. The constant error obtained is usually 130 to 200 m. Also the calibration points should be counted and registered for future adjustment of the coupling unit of the optical bomb sight ( Chapter I, §2).

## § 22. Inspection and adjustment of the coupling unit of the optical bomb sight on the stand.

In this paragraph the methods used for inspection and adjustment of the coupling unit of the optical bomb sight in the workshop are discussed.

### A. Inspection of the position of the longitudinal and transverse markers.

1) Set the switches on the timer and control unit in the following sequence: "Range delay x 10 km" to position "0".
"Tube switch" to position "1"
"Range in km" to position "10-60",
"Antenna control On-Off" to position "Off"
"Operation-Calibration" to position "Operation".
The "R.F.gain", "Time gain control " and "Expansion 10-60" control knobs should be turned in anti-clockwise direction to their extreme positions and the switch on the azimuth stabilization unit should be placed to position "Optical bomb sight".

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he "Power convertor On-Off", "Power mains 97V- 115V" and
ansmitter heating" switches to position "On",
h in the antenna rotation mechanism and use the cursor on
lan position indicator filter to measure the position of
longitudinal marker on the screen of the plan position
indicator. The longitudinal marker may be divergent in reference to the zero of the azimuth scale by an angle of not over ± 1 ( the regulation of the position of the longitudinal marker is described in § 13, Item 2). Switch off the antenna rotating mechanism.

3) Turn the "Range" control knob of the computing mechanism and shift the measurement pulse to the center of the sweep on the screen of the plan position indicator. Note the indication on the scale of the computing mechanism drum ($R_1$).

4) Shift the measurement pulse to obtain its coincidence with the transverse marker and note again the indication of the scale on the computing mechanism drum ($R_2$).

5) Calculate the distance of the transverse marker from the center of the sweep from the following formula:

$$\Delta = R_1 - R_2$$

where: $\Delta$ = the distance between the transverse marker and the center of the sweep ( in metres)

$R_1$ = the distance corresponding to the position of the measurement pulse in the center of the sweep (in me

$R_2$ = the distance corresponding to the coincidence of the measurement pulse with the transverse marker ( in metres).

transverse marker should be placed at a distance of not 500 m from from the center of the sweep. If this marker bed at a greater distance, the 29-02 (6N8S) tube in the ng unit of the optical bomb sight should be replaced to bring ker to the center of the sweep. On the radar bomb sight equip oduced in 1952 ( series Nos.101 and up) the position of the rse marker may be adjusted with the R 2903 potentiometer.

nspection and adjustment of the course channel in the ing unit of the optical bomb sight.

the antenna so that the cam on the base of the antenna es the miniature switch of the course marker, and remove over from the azimuth differentiating mechanism, covering 01 potentiometer.

2) t a zero angle of sight on the optical bomb sight. The scope should be locked.

3) Inspect the correct position of the drift angle scale on the base under the optical bomb sight unit. The pointer, coupled with the shaft of the optical bomb sight, should be set to zero reference of the scale, and the "Delay" lever of the optical bomb sight unit should be moved from zero to 360/1000. With correct position of the zero reference of the scale on the base of the unit the moving of the delay lever should cause no shift of the sweep on the screen of the plan position indicator as well as of the calibrated gear of the azimuth differentiating mechanism. If this is not true, correct the position of the scale. Note, from the pointer, the angle on the gear-scale on the azimuth differentiating mechanism, corresponding to zero drift angle. The sweep on the screen of the plan position indicator should be closed to the zero.

N o t e : The gear with the calibrated scale, as well as the pointer on the azimuth differentiating, should be observed through the opening placed close to the R 1701 potentiometer of the optical bomb sight unit.

4) the lever of the delay instruction in the optical bomb sight zero position. The angle of sight should be set to $70^{\circ}$.

5) n the pointer, coupled with the shaft of the optical bomb ht unit, in clockwise direction by an angle of $30^{\circ}$ from the drift angle. The calibrated gear of the azimuth differentia- mechanism should turn by an angle of $30 \pm 1^{\circ}$ from the posi- n considered as zero reference ( see Item 3).

n the pointer couple to the shaft of the optical bomb sight t, by an angle of $30^{\circ}$ in anti-clockwise direction from the of the drift angle. The calibrated gear of the azimuth dif- ntiating mechanism should turn by an angle of $30 \pm 1^{\circ}$ from position, considered as zero reference ( see Item 3).

angles of deflection of this gear outside of [illegible] li-
of 30 ±1°, the course channel should be adjusted in the
wing way:

move the cover of the coupling unit of the optical bomb
ight.

urn the pointer coupled to the shaft of the optical bomb
ight from its position, considered as zero drift angle,
y 30°, and after the gear stops turn the axle of the R 31
potentiometer in the coupling unit of the optical bomb sight
until the gear turns by 30° from its position, in which it
was found with the zero drift angle.

c) Turn the pointer coupled to the shaft of the optical bomb sight to the position, corresponding to zero drift angle. After the gear has stopped, turn the axle of the R 05 potentiometer in the coupling unit of the optical bomb sight until the gear is set to the position in which it was during the inspection described under Item 3.

d) Repeat the adjustment of the R 31 and R 05 potentiometers, until the gear of the azimuth differentiating mechanism turns by an angle of 30° after the drift angle had changed by the same value.

8) Inspect the accuracy of the performance of the course channel of the coupling unit of the optical bomb sight. The inspection is done by turning the shaft of the optical bomb sight in steps of 5° to 30° both in the clockwise and anti-clockwise direction from the position corresponding to zero drift angle. Each time note the angle of deflection of the gear of the azimuth differentiating mechanism. The error in the performance of the course channel is obtained from the difference between angle of deflection of the shaft of the optical bomb sight t and the angle of deflection of the gear of the azimuth ferentiating mechanism. The error should not exceed ±0,5° drift angles up to 20° and ± 1° for drift angles from 20 30°.

in some individual points the error exceed the admissible ue, the R 31 and R 05 potentiometers should be adjusted to rease the error to the admissible value. However, care s uld be taken with this compensation that the error in other itions does not exceed the admissible value.

t e i The adjustment of the course channel in the [illegible] of the optical bomb sight in the apparatus of series Nos.101 up is done by means of the R 2915 and R 2916 potentiometers, ed "Drift angle calibration". The axles of the potentiometers accessible from the front panel of the coupling unit of the cal bomb sight. The adjustment is done in the same way as described above.

nspection of the rate of change of the error angle compensation in the coupling unit of the optical bomb sight.

urn the shaft of the optical bomb sight by an angle of 30° in clockwise direction relative to zero drift angle.

fter the sweep on the screen of the plan position indicator stops, turn swiftly the shaft of the optical bomb sight unit by an angle of 60° in anti-clockwise direction, and, at the same time, switch in the stop-watch. The watch should be switched off in the moment of the stop of the sweep.

Calculate the rate of change of the error angle compensation in the coupling unit of the optical bomb sight from the following formula:

$$\omega = \frac{60}{t}$$

where: $\omega$ = rate of change of the error angle compensation (degrees per second)

t = time measured by the stop-watch

The rate of change of the error angle compensation should be at least 4,5 degrees per second.

D. ibration and inspection of the accuracy of performance of traverse stabilization channel of the coupling unit of the optical bomb sight.

1) t the shaft of the optical bomb sight unit to a position esponding to zero drift angle. The lever of the delay inction should be set to zero position.

2) e bank angle, scale on the base of the optical bomb sight t the zero bank angle, and with the levels of the locked

gyroscope adjust the horizontal position of optical bo50X1-HUM
Check the correct position of the zero bank by varying the angle of sight of the optical bomb sight from 20 to 70°. The sweep on the plan position indicator, as well as the gear of the azimuth differentiating mechanism, should not move. If they do move, note the position of the gear on the azimuth differentiating mechanism with the angle of sight of 70°. Adjust an angle of sight of 20° and, by turning the axle of the R 07 "Zero bank adjustement" potentiometer, return the gear to the position in which it was with the angle of sight of 70°. Then vary the angle of sight from 20° to 70°. If the gear of the azimuth differentiating mechanism turns, repeat the adjustment. Switch in the power supply of the optical bomb sight gyroscope and let it rotate for 20- 30 minutes.

4) On the bank angle scale of the base of the optical bomb sight, adjust the 10° bank angle. The angle of sight should be set to 45°. Loosen the gyroscope and by means of the correction pointers on the optical bomb sight adjust the vertical axis of the gyroscope using the levels installed on its body. The gear of the azimuth of 10 ±1° from the position in which the bank angle was zero. If this is not so, turn the axle of the R 26 potentiometer marked "Transverse stabilization adjustment" until the gear of the azimuth differentiating mechanism turns by 10°.

5) Adjust progressively the bank angles on the base of the optical bomb sight unit as well as the angles of sight on the optical bomb sight according to Table 3, and each time keep the axis of the gyroscope in its vertical position by means of the correction pointers. The position is to be measured with the levels. Check also the accuracy of the performance of the transverse stabilization channel of the coupling unit of the optical bomb sight. With each measurement the angle of deflection of the gear of the azimuth differentiating mechanism should be written down.

6) After the measurement the error in the transmission of the angle through the bank channel in the coupling unit of the optical bomb sight should be calculated from the following formula:

$$\Delta = \gamma \operatorname{otg} \beta - \alpha$$

where: $\Delta$ = error in the transmission of the bank angle
$\gamma$ = bank angle of the optical bomb sight unit
$\beta$ = angle of sight
$\alpha$ = angle of deflection of the gear of the azimuth differentiating mechanism.

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Table 3.

sults of the inspection of the transversal stabilization
annel of the coupling unit of the optical bomb sight.

| nk angle the opti- l bomb ght (μ) (degrees) | Angle of sight β° | Required angle of the gear of the azimuth differentiating mechanism μctg β (degrees) | Angle of rotation of the gear 1° | Error in the transmission of the angle Δ° |
|---|---|---|---|---|
| | 20 | + 13,7 | | |
| + 5 | 45 | + 5 | | |
| | 60 | + 2,9 | | |
| | 20 | + 27,5 | | |
| +10 | 45 | + 10 | | |
| | 60 | + 5,8 | | |
| | 20 | + 41,2 | | |
| +15 | 45 | + 15 | | |
| | 60 | + 8,7 | | |
| | 20 | + 55 | | |
| +20 | 45 | + 20 | | |
| | 60 | + 11,5 | | |
| | 20 | - 13,7 | | |
| 5 | 45 | - 5 | | |
| | 60 | - 2,9 | | |
| | 20 | - 27,5 | | |
| 10 | 45 | - 10 | | |
| | 60 | - 5,8 | | |
| | 20 | - 41,2 | | |
| 15 | 45 | - 15 | | |
| | 60 | - 8,7 | | |
| | 20 | - 55 | | |
| 0 | 45 | - 20 | | |
| | 60 | - 11,5 | | |

The error in the transmission of the angle through the manual stabilization channel should not exceed $\pm 1^{\circ}$ with bank angles up to $10^{\circ}$ and $\pm 3^{\circ}$ with angles above $10^{\circ}$.

E. Inspection of the performance accuracy of the slant range synchronization channel in the coupling unit of the optical bomb sight.

This inspection should be done after 20- 30 minutes of operation of the radar bomb sight equipment.

1) Set the "Operation-Calibration" switch to position "Calibration" Swicth in the high voltage of the transmitter.

2) Inspect the accuracy of calibration in the following points: altitude ( 2-a) km, angle of sight $0^{\circ}$; altitude (10-a) km, angle of sight $0^{\circ}$; altitude ( 10-a/2) km, angle of sight $60^{\circ}$ ; altitude ( 1-a/2) km angle of sight $60^{\circ}$, where "a" is the constant error in range measurement.

If a supplementary adjustment is necessary, use the method explained in Chapter I., §3.

3) Install the angle of sight of $0^{\circ}$ and , by turning the "Altitude" control knob on the optical bomb sight unit, obtain a coincidence of the transverse marker on the monitoring tube with the first, second, third, etc. two-kilometers pulses following after the transmitter pulse. Each time note the altitude indication from the "altitude" drum-scale of the optical bomb sight unit.

The coincidence of the pulses is achieved by the method described in Chapter I., § 3 B, Item 5.

The error of the range channel performance should be calculated from $\Delta_{\text{з}} = H - a - 2.000\ n$,

where: $\Delta_{\text{з}}$ = error of the range channel performance (m)

$a$ = constant error of the range measurement (m)

$n$ = number of the two-kilometer pulse, following after the transmitter pulse, which should coincide with the transverse marker.

The error in the performance of the range channel should not exceed $\pm 80$ m with altitudes up to 4.000 m and 2% with altitudes above 4.000 m.

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Inspect the accuracy of the performance of the range channel w with the variation of the angle of sight at an altitude of 10000 m. For this, install successively the respective angles of sight according to Table 4 and, by turning the "Altitude" handle of the optical bomb sight within the limits of 9,400 and 10,400 m, obtain the coincidence of the transverse marker with the two-kilometer marker, the number of which is also given in Table 4.

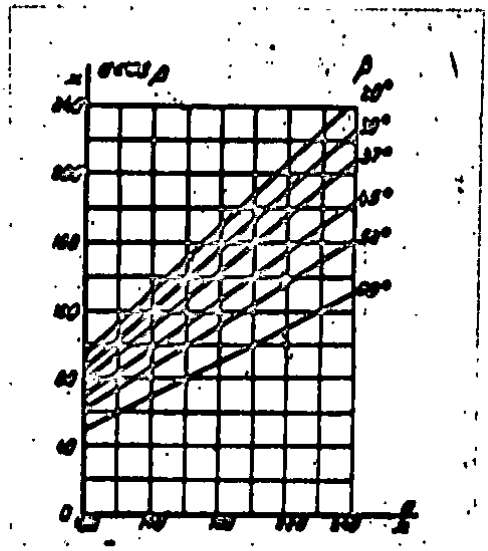

Fig. 19. Nomogram for the evaluation of the " a cos$\beta$ ".

t e : The error of the range channel of the coupling unit of the bomb sight should be found as described above except the omission of the constant error in the range measurement ("a").

Measurement of the length of the transmitter pulses.

The transmitter pulse length is measured with the 251 synchro-e. For the detection of the r.f. pulses of the transmitter the ctor circuit of the signal generator type 31 IM is used. Also detector cirquit of the wavelength meter type 35 IM can be used. instruction considers the application of both meters. e measurement may be performed both on the workshop stand as as on the aircraft.

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Table 4.

of inspection of the range accuracy of synchronization in the coupling unit of

| Δ of si | No.of the pulse to be used in the measurement "n" | Altitude "$H_o$" | Constant error in the range measurement a cos β | Altitude Error indication on the optical bomb sight Δ "H" | Δ of si err |
|---|---|---|---|---|---|
| 20 | 5 | 9400 | | ± 190 | |
| 30 | 6 | 10390 | | ± 170 | |
| 37 | 6 | 9600 | | ± 160 | |
| 45 | 7 | 9900 | | ± 140 | |
| 52 | 8 | 9850 | | ± 120 | |
| 60 | 10 | 10000 | | ± 100 | |
| 20 | 3 | 5640 | | ± 95 | |
| 30 | 3 | 5196 | | ± 85 | |
| 37 | 3 | 4790 | | ± 80 | |
| | 4 | 5657 | | ± 70 | |
| | 4 | 4925 | | ± 60 | |
| | 5 | 5000 | | ± 50 | |

In each of the inspected points the reading of the drum-scale "Altitude" of the optical bomb sight should be written down.

Repeat this inspection for the altitude of 5,000 m. The error in the measurement of the range channel shou be calculated from

$$\Delta_n = H_o - a \cos\beta - H$$

where $\Delta_n$ = error in the measurement of the range ch
$H_o$ = the respective amplitude for each of the of sight (m)

a = constant error in the range

$\beta$ = angle of sight

H = the altitude, indicated on the drum-counter of the optical bomb sight unit.

The values $H_o$ for each of the respective angles of sight are given in Table 4 where also the admissible values of error in the measurement of the range channel are presented for various angles of sight. The " a cos$\beta$ " value for the respective values of " a" and " cos$\beta$ " may be found in the nomogram in Fig.19.

## Measurement of the transmitter pulse length with the synchroscope and signal generator, type 31IM.

Remove the protective lid from the waveguide output of the 31 IM signal generator and attach to the instrument ( by means of holders) the supplementary attenuator and the horn antenna from the meter accessory equipment 31 IM. Install the instrument so that the broad side of the horn antenna is in the vertical plane.

Connect, with a coaxial cable from the meter, accessories 25IM the Šr-2 connector ( on the left side of the meter) and the left receptacle "Input" of the synchroscope 25 I ( the signal input).

Install, at a distance of 4-5 m from the antenna of the radar bomb sight, the signal generator 351 and the synchroscope 31IM. The arrangement of the apparatus is shown in Fig.20. The measurement of the length of the transmitter pulses may be performed simultaneously with the measurement of the transmitter power output according to Fig.22.

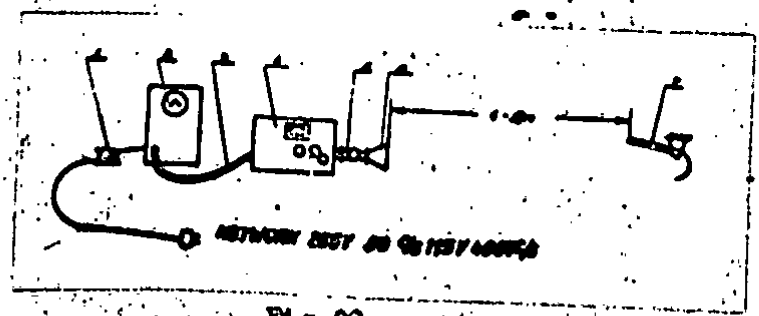

Fig.20.

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Fig. 20: Arrangement of the apparatus for the length of the transmitter pul...
1 - drum with the power supply cable ... accessories ( with measuroment aboard t... craft), or a habitual two-conductor cable.
2 - synchroscope, type 25 I
3 - coaxial cable from the 25 I accessories
4 - signal generator, type 31 IM
5 - supplementary attenuator from the 31 IM accessories
6 - horn antenna
7 - antenna of the radar bomb sight

4) Switch in the power supply cable of the synchroscope to 200 V 50 c.p.s. or 115 V 400 c.p.s. mains. If the measurement is done on the aircraft, the synchroscope should be supplied by means of the cable from the 31 IM accessories which is connected to the receptacle on the control panel of the power converter.

5) Cut on the power supply of the radar bomb sight equipment and the 25 I synchroscope ( the "Brightness" control knob). Direct the radar bomb sight antenna towards the horn antenna of the signal generator.

6) Set the synchroscope switches to the following positions:
" Input signal attenuation control" to position " 1:5".
" Input resistance and attenuation" to position "1:1".
" Sweep" to position "Waiting"
" Time" to position" 2 microseconds"
" Length calibartion" to position "On"
" Amplitude calibration" to position "Off"
" Synchronization control: Internal-External" to position " Interanl"
" Synchronization control + or - " to position " - ".
The "Gain" control ( the control of the gain of the synchronization signal) turn in clockwise direction to its extreme position.
Set the switch " Type of operation" on the signal generator panel 31 IM to position "Pulse detector Volts". The signal generator need not be supplied from the power source during this measurement. The control knob of the supplementary attenuator turn in clockwise direction to its extreme position ( 100th

division scale). 50X1-HUM

8) Set the "Range in km" switch on the time... the radar bomb sight to position "10-60", t... switch to position "Scanning", and switch in the high volt... of the transmitter.

9) Decrease the attenuation of the supplementary attenuator until the sweep and the envelope of the detected transmitter pulse are presented in the screen of the synchroscope.
If neither the sweep nor the pulse are presented even with a fully open attenuator, inspect the position of the antenna of the 31 IM and the PSBN-M and turn the instrument and radar bomb sight antenna to a position in which the sweep is presented on the screen of the synchroscope. If the sweep display is still not visible, check the correct functioning of the 31 IM detector and, if necessary, replace it.
Turn the "Gain" control knob ( amplification of the synchronization) on the 251 meter until a stable display is presented on the screen of the synchroscope.

10) By means of the "Attenuation" and "Continuous" control knobs adjust the height of the pulse equal to 3-5 divisions of the screen of the synchroscope.

11) Turn the "Brightness" control knob of the synchroscope to decrease the brightness of the display on the screen so that the calibration markers be clearly visible on the pulse curve. Measure the length of the pulse using the calibration markers. Each marker corresponds to 0,1 microsecond. The measurement of the markers should be done at a level of 0,7 of the pulse peak. The length of the pulse should be 0,3 to 0,4 microsecond.

12) Set the "Range in km" switch on the radar bomb sight to position "100" and by the same method measure the length of the pulses which should be 0,9- 1.1. microsecond.

13) Set the "Beacon- Scanning" switch to position "Beacon" and measure the length of the pulse which should be 1.9 to 2.2 microsecond. After the measurement return the switch to position "Scanning".
The display of the pulses obtained on the screen of the synchroscope with the measurement of their length, are shown in Fig. 21.

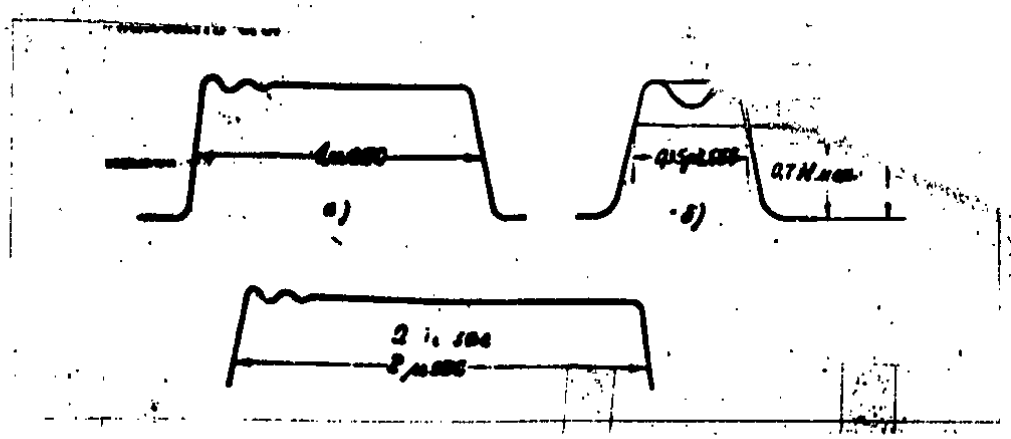

Fig. 21. - Display on the screen of the synchroscope with the measurement of the pulse length:
a - the 1 microsec. pulse
b - the 0,35 microsec. pulse
c - the 2 microsec. pulse

B. Measurement of the length of the transmitter pulse with the wavelength meter, type 35 IM and the synchroscope, type 25 I

Connect the " Oscilloscope" receptacle on the 35 IM meter with the "Input" receptacle ( i.e. the signal input) of the synchroscope. Attach the horn antenna to the waveguide output of the wavelength meter. The meter is to be installed in vertical position and its horn antenna should point towards the radar bomb sight antenna. The "Attenuation" control knob of the attenuator of the meter turn in anti-clockwise direction to its extreme position. The " Oscilloscope- Meter" switch on the wavelength meter set to position "Oscilloscope", The further operations should be performed in the same way as described in Items 3 to 13 of preceding paragraph.

If the inspection is performed on the stand, the antenna of the radar bomb sight need not be attached to the transmitter, and instead of that the horn antenna should be connected through a twist joint to the waveguide output of the transmitter.

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## § 24. Measurement of the average power of the t

The average power of the transmitter is measured with . nal generator, type 31 IM or with the watt-waveguide meter, ty. 34 IM a directional coupler and a dummy antenna from the accesso - ries of the 52 I meter.

As the 31 IM and 34 IM type meters are not intended for measurement of great powers, and may be used directly only with small power ( not over 1 watt), they are used for measuring of only a very small part ( 0.001) of the r.f. power supplied by the magnetron of the transmitter. The greater part of the r.f. energy is fed to a dummy antenna where it is dissipated. A special direction coupler ( T-junction) is used for the distribution of the r.f. power to the meter and the dummy antenna. If the coupler from the 52 I accessories is used, 1/1000 of the r.f. energy supplied enters the meter, i.e. the attenuation of the power entering the directional coupler is 30 db ( the exact attenuation value is given in the papers of the individual directional coupler.).

In the repair shop the r.f. power output of the transmitter can be measured with the calorimetric power meter, type 3[illegible] I. In the following section the method used in the measurement of the av e - rage power of the transmitter magnetron with the 31 IM and 34 IM meters is described.

### A. Measurement of the average transmitter power with the signal-generator, type 31 IM.

The measurement of the transmitter power output may be performed both in the repair shop and aboard the aircraft. The method used is the following one:

1) Disconnect the waveguide from the transmitter and the antenna of the radar bomb sight equipment. If the measurement is done aboard the Il-28 aircraft, its antenna need not be disconnected, it is sufficient to disconnect the antenna from the transmitter and to tilt the transmitter downwards.
Connect the transmitter through the waveguide joints with the signal generator 31 IM according to Fig.22, if the measurement is performed in the repair shop, and according to Fig.23 with measurement aboard the aircraft.

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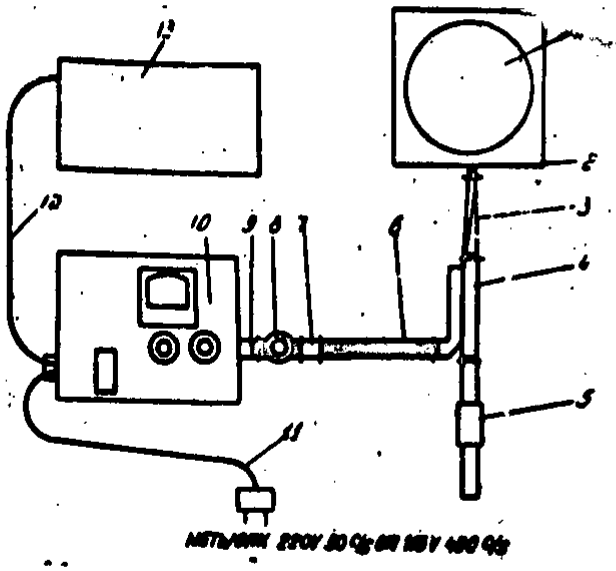


Fig. 22- Arrangement of the apparatus with the measurement of the average power of the transmitter and the lenght of transmitter pulses:

1 - transmitter of the radar bomb sight
2 - waveguide output of the transmitter
3 - twist waveguide joint
4 - directional coupler
5 - 50- watt dummy antenna
6 - flexible waveguide
7 - waveguide element with two flat flanges
8 - supplementary attenuator, type 31 IM
9 - waveguide output of the 31 IM signal-generator
10 - signal generator, type 31 M
11 - power supply cable of the signal generator
12 - coaxial cable of the 25 I
13 - synchroscope, type 25 I

During the measurement the instruction on the connection of waveguide elements should be observed ( see Chapter IV, §2). The power supply cable should be connected to a 220 V 50 c.p.s or 115 V 400 c.p.s. power source ( receptacle on the power convertor control panel).

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The supplementary attenuator is inserted into the waveguide chain to protect the detector. If no detector is used in the 31 IM meter, the supplementary attenuation may be omitted.

In the course of the measurement the coaxial cable of the waveguide- to- coaxial joint should never be twisted or bent in a radius of under 30 cm as such bents influence infavourably the accurancy of attenuation of the cable and thus the indication of the 31 IM meter.

2) Set the switches on the signal-generator to their following positions: "Generator Off-On" to position "Off"
"Type of operation" to position "Continuous 1"
"0,5 mW- 1mW" to position " 1mW"
"Meter stabilization-Operation" to position "Stabilization"
"On-Off" to position "Off"

The control knobs of the attenuators should be turned in clockwise direction to their extreme positions ( 100-th division on the scale).

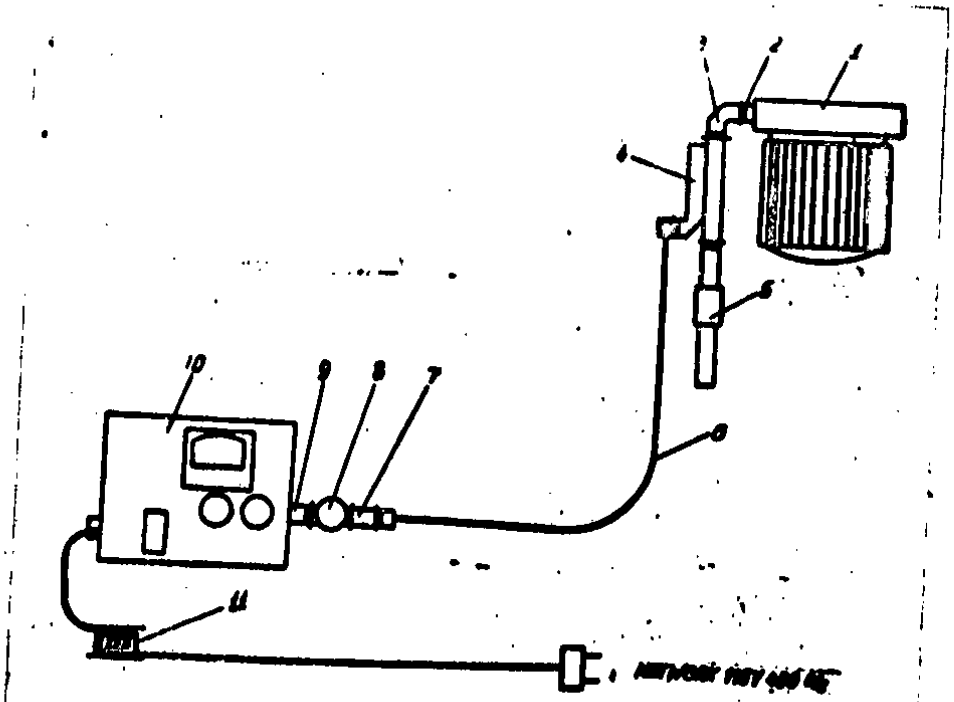


Figure 23.

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Fig-23:- Arrangement of the apparatus for measurement of the average transmitter power aboard the aircraft:
1 - transmitter of the radar bomb sight
2 - waveguide output of the transmitter
3 - flat waveguide corner
4 - directional coupler
5 - dummy antenna ( 50W)
6 - waveguide - to-coaxial joint
7 - waveguide element with two flat flanges
8 - supplementary attenuator of the 31 IM equipment
9 - waveguide output of the 31 IM signal generator
10 - signal generator, type 31 IM
11 - drum with the power-supply cable

3) Switch in the power -supply of the radar bomb sight and the signal generator (.the "On-Off" switch in the left lower part of the panel.
4) Switch in the signal generator and after 4-5 minutes calibrate the power-output meter of the signal generator by this method:
a) The "Meter" switch should be set to position "Stabilization" and the "Bridge supply stabilization" control knob should be regulated to adjust the pointer on the scale exactly to the 2 mW reference point.
b) Set the "Meter" switch to,position "Operation" and use the "Measurement" switch to adjust the pointer of the power-output meter to the left side of the scale close to the zero, and then turn the "Continuous zero adjustment" control knob to set the pointer exactly to zero reference.
c) Set the "Measurement" switch to a position higher by one step as compared with that in which the zero on the scale of the power output meter was adjusted. After this the pointer of the power output meter should move to a position corresponding to 1 mW. If the position of the pointer is a different one, it should be adjusted by means of the "Sensitivity" control.
Set the "Measurement" switch to a position by one step lower than that in which the L mW reference power was adjusted, and check the position of the pointer ( it should be zero).

Then check the position of the pointer on the 1 mW reference point as described under "c" etc., until after switching the "Measurement" switch the pointer will stay on the both positions of 0 and 1 mW, respectively.

Example: The initial zero adjustment, as described under "b", was performed in position "IV" of the "Measurement" switch. To calibrate the power-output meter in the 1 mW reference point set the "measurement" switch to position "V" and adjust the pointer to 1 mW by means of the "Sensitivity" control. Then set the "Measurement" switch to position "IV" and check the zero position of the pointer ( within the limits of one small scale-division to the left and right of the zero reference point). If the pointer zero is not obtained, turn the "Continuous zero adjustment" control knob to move the pointer to its zero position. Then set the "Measurement" switch to position "V" and inspect the position of the pointer on the 1 mW reference point, etc.

5) Switch in the transmitter high voltage and set the "Range in km" switch to position"100".
6) Adjust the voltage of the power-supply of the radar bomb sight to exactly 115 V and inspect, on the meter of the front panel of the timer and control unit, the value of the average magnetron current ( in position "Magnetron current" of the "Magnetron current-Detector current" switch). The current obtained should be 10 ma. If the current has a different value, adjust it with the R 1118 " Magnetron current" variable resistor, the axle of which is accessible from the side panel of the transmitter unit. If the limits of adjustment by means of this resistor are too narrow, adjust the O 1101 switch installed also on the side panel of the transmitter unit. By the adjustment of this switch the value of the magnetron current is changed in steps ( the first position of the switch corresponds to the minimum current, the third to the maximum, and the fourth the switching off).
7) By means of the "Stabilized operation" and "Measurement" controls on the 31 IM instrument inspect the calibration of the instrument in the positions of 2 mW, 0mW and 1mW and, if necessary, repeat the adjustment. The attenuator control knobs of the instrument should be in positions corresponding to the maximum attenuation ( 100th division of the scale).

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8) Set the controls of the attenuators "I" and "II" of the 31 IM instrument to positions corresponding to 10 scale-divisions (the supplementary attenuator is set to the 100th scale division).

9) Decrease the attenuation of the supplementary attenuator until the pointer of the meter deflects to the 1 mW reference mark on the scale.

Note the position of the pointers on the scales of the attenuators.

Note: If the supplementary attenuator is not connected, the attenuation during the measurement should be changed by means of one of the fundamental attenuators "I" or "II". The other attenuator should be set to the 10th or 20 th scale-division.

10) Read the attenuation, introduced by each of the attenuators, from the calibartion charts in the papers of the 31 IM instrument.

11) Calculate the overall attenuation of the output power, in reference to the value of 1 mW, from the formula

$$\gamma = \gamma_0 + \gamma_n + \gamma_I + \gamma_{II} + \gamma_{III} + \gamma_b$$

where: $\gamma_0$ = attenuation of the output power in the directional coupler ( in db)

$\gamma_n$ = attenuation of the waveguide-to waveguide coaxial joint ( with the measurement according to Fig.23) or the attenuation of the flexible waveguide ( as per Fig.22). ( in db).

$\gamma_I$ = attenuation introduced by the "I" attenuator in the 31 IM ( in db).

$\gamma_{II}$ = attenuation, introduced by the "II" attenuator in the 31 IM ( in db).

$\gamma_{III}$ = Attenuation, introduced by the supplementary attenuator in the 31 IM instrument ( in db).

$\gamma_b$ = attenuation at the beginning of the waveguide chain of the 31 IM instrument.

The value of $\gamma_0$, viz. the attenuation of the output power in the directional coupler ( approximately 29,5 to 30,5 db) is given in the papers of the 52 I instrument.

The value of $\gamma_n$, viz the attenuation in the waveguide 50X1-HUM veguide coaxial joint ( approximately 6 to 10 db) is given in the papers of the 31 IM instrument, and, in addition, on the annexe of the cable connector.

The attenuation of the flexible waveguide ( 0,1 to 0,2 db) is given also in the papers of the 31 IM instrument.

The value of $\gamma_b$ is to be found with the inspection of the instrument and should be approximately from 0,8 to 1,2 db.

12) The obtained value of the attenuation, expressed in decibels in reference to 1 mW, should be converted to absolute value of power output from Table 5. The value of the average power output of the transmitter should be at least 36 W.

Table 5

Power output, expressed in decibles in reference to 1 mW and its absolute value.

| Power in db in reference to 1 mW | Power in Watts |
|---|---|
| 43,01 | 20 |
| 43,42 | 22 |
| 43,80 | 24 |
| 44,15 | 26 |
| 44,47 | 28 |
| 44,77 | 30 |
| 44,91 | 31 |
| 44,05 | 32 |
| 45,18 | 33 |
| 45,31 | 34 |
| 45,44 | 35 |
| 45,56 | 36 |
| 45,68 | 37 |
| 45,80 | 38 |
| 45,91 | 39 |
| 46,02 | 40 |
| 46,23 | 42 |
| 46,43 | 44 |
| 46,63 | 46 |
| 46,81 | 48 |
| 46,99 | 50 |
| 47,40 | 55 |
| 47,78 | 60 |

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In the following an example is presented of the calculation of the average power of the transmitter magnetron.

Example: The measurement was performed according to Fig.23 after the operations described in Item I to 8 have been performed. A supplementary attenuator was used to establish the pointer on the meter scale to reference 1 mW, and then the bridge was balanced according to description in Item 9.

Note the position of the control knobs of all the attenuators and compare it with the value given in the attenuator charts in the papers of the 31 IM instrument, giving the attenuation of each attenuator ( at the frequency of 9,370 Mc/s).

The attenuator I, in the 10th scale-division, has a value of $\int_I = 0,8$ db.

The attenuator II, in the same position, has a value of $\int_{II} = 0,6$db

The attenuator III ( supplementary), in the 34th scale-division, has a value of $\int_{III} = 6,5$ db.

The attenuation of the directional coupler is $\int_c = 30,2$ db.

The attenuation of the waveguide-to coaxial joint is $\int_n = 6.8$ db

The attenuation in the beginning of the waveguide chain of the instrument is $\int_b = 1$ db.

The overall attenuation is

$30,2 + 6,8 + 1 + 0,8 + 0,6 + 6.5 = 45,9$ db.

From the Table 5 may be found that this value corresponds to a power output of 39 W.

The power output measurement may be also performed by a more exact method, viz the balanced bridge method. This is performed as follows:

a) Perform the Items 1,2 and 3.

b) Calibrate the power output measuring instrument in reference points of 2 mW and zero, as described in Item 4, "a" and "b".

c) Switch in the transmitter and check its operation according to Items 5 and 6.

d) Check the calibration of the power output measuring instrument in reference points of 2 mW and zero ( with the maximum attenuation of the attenuators).

e) Set the"measurement" switch to a position lower by one step as compared with the position in which the zero reference was calibrated. Turn the control knobs of the attenuators and balance the thermistor bridge(i.e. bring the pointer to the zero reference of the scale).

f) Read, from the scales of the attenuators, their respec50X1-HUM lues and calculate the power output of the transmitter, as explained in Items 10, 11 and 12.

B. Measurement of the average power of the transmitter with the wattmetr and wavelengthmeter, type 34 IM.

The measurement of the power output with the watt and wavelength meter is fundamentally the same as the measurement by means of the 31 IM instrument. Further only some difference in the measurement will be described.

1) Connect the instrument 34 IM with the transmitter of the radar bomb sight according to Fig.22 and 23. The supplementary attenuator need not be attached to the waveguide output of the instrument.

2) The power supply is fed to the instrument from the battery installed in its case or, with the temperature of the ambient air under -16°C, from an external D.C. 24V source ( an aircraf accumulator battery). The "Power supply" switch on the instrument panel should be switched accordingly to the respective position "Internal" or "External".

3) The calibration of the instrument is done in the following way:
   a) Set the switch on the front panel of the instrument to position "Supply stabilization" and by turning the "Bridge supply stabilization" control knob, adjust the pointer of the output power meter to the 2 mW reference on the scale.
   b) Set the switch to position " Measurement in steps" and, by means of the "measurement" switch, adjust the pointer of the meter to the vicinity of the zero reference on the scale.
   c) Set the switch to position "Exact measurement" and with the "Zero adjustment" control adjust the pointer of the meter to zero reference.
   d) Set the "Measurement" switch to a position higher by one step as compared with that in which the zero was adjusted. Adjust the pointer of the meter to the 1 mW reference with the "Sensitivity" control.
   e) Set the "Measurement" control knob to the same position in which it was adjusted during the operation described under "c" and inspect the adjustment of the pointer to the zero

reference. If necessary, repeat the zero adjustment. After that inspect the position of the pointer on the reference mark of 1 mW etc.

4) The measurement of the attenuation should be done by means of one of the attenuators of the 34 IM instrument.
The measurement may be performed with the out-of balance bridge (less accurate) or with the bridge balanced ( exact) If the balance-bridge measurement method is used, the calibration in the 1 mW reference point need not be performed, and the "Sensitivity" control should be set to its extreme right position.

§ 25. Measurement of the operation frequency of the transmitter.

The measurement of the operation frequency of the transmitter may be done by means of any of the instruments described: the signal generator, type 31 IM, The watt and wavelength-meter, type 34 IM, the wavelength meter, type 35 IM, or the checking resonator, type 501.

The measurement of the transmitter frequency should be done simultaneously with the inspection of other characteristics of the equipment.

Example: The measurement of the frequency with the 31 IM or 34 IM type instruments can be done with the measurement of the transmitter power output. The measurement of the frequency with the checking resonator can be done in the course of the tuning and inspection of the receiver of the radar bomb sight. The measurement of the frequency with the aid of the wavelength meter type 35 IM may be done simultaneously with the measurement of the length of the transmitter pulses.

Thus the further described methods of measurement of the transmitter frequency by means of the mentioned instruments have been treated in view ofthis facility.

a. Measurement of the operation frequency of the transmitter with the signal generator, type 31 IM, or the watt-and wavelength-meter, type 34 IM.

The measurement is done after the measurement of the average power output of the transmitter according to Fig.22 and 23, in

the following sequence:

1) Be sure that the power output meter in the 31 IM instrument ( or in the 34 IM) indicates a r.f. power of 0,8 to 1,5 mW.
2) Turn the "Frequency" control knob within the limits of 10.00 and 13.00 divisions of the front panel scale of the instrument, 31 IM or 34 IM, until the power output meter indication abruptly decreases. Turn the "Frequency" control knob slowly to the left and right until a minimum indication of the pointer of the power output meter is obtained. Now the wavelength meter is exactly tuned to the frequency measured.
3) Read on the wavelength-meter scale ( on the front panel of the respective instrument 31 IM or 34 IM the number of the division, corresponding to the frequency measured.

The reading should be done in the following way:

From the right hand vertical scale, integral numbers are read by means of a red horizontal line.

From the lower horizontal scale the tenths and hundredths are read by means of a vertical line. The horizontal scale is divided into only 50 small divisions, and each of these divisions corresponds to 1/100 of a division on the vertical scale. Thus in reading the indications also the indication of the left vertical scale should be noted. The values of the divisions of the left scale corresponds to those of the right scale, however, they are shifted by a half division. Thus if in reading the scale the next lower division in reference to the marker line is found on the right scale, the value indicated on the right scale should be added to the indication of the lower scale ( the right vertical scale indicates the integral numbers, while the lower scale indicates tenths and hundredths). If the next lower division in reference to the marker line of the vertical scale is found on the left scale, 50 hundredths should be added to the indication of the lower scale.

An example will explain the method of reading.

Example 1. Read the frequency from the instrument scale according to Fig.24 a. The right vertical scale indication is 12, and the horizontal scale indication is 0,225. The next lower division in reference to the marker line is the right scale division and thus theresult is 12.225.

Example 2: Read the indication according to Fig.24b. Eleven great divisions are read on the vertical scale and 0,362 on the lower scale. The next lower division in reference to the marker line of the vertical scale is found on the left scale, and thus 0,50 should be added to the indication of the lower scale. The result is 11.862.

Fig. 24: The scale of the wavelength-meter of the signal generator, type 31 IM or the watt-and wavelength-meter, type 34 IM:
1 - right vertical scale
2 - left vertical scale
3 - horizontal marker line
4 - vertical marker line
5 - horizontal scale

4) The reading obtained should now be converted to frequency units, i.e. to Mc/s in the following way:
a) Find from the "Reading" column in the respective table situated on the front panel of the measuring instrument to next higher value of the wavelength meter scale, corresponding to the wavelength number ( column "Wavelength number" in the table

The number, indicated in this column, expresses the wavelength. An example of the table of the meter is given in Table 6.

Table 6.

Example of the calibration table of the wavelength-meter, type 31 IM or 34 IM.

| Wavelengt' number | Reading | Value of one scale-division |
|---|---|---|
| 98 | 11.229 | 0,65 |
| 99 | 11.677 | 0,67 |
| 100 | 12.083 | 0,73 |
| 101 | 12.464 | 0,79 |
| 102 | 12.895 | 0,70 |
| 103 | 13.316 | 0,71 |

b) Subtract from the next higher indication of the wavelength meter, given in the table, the reading obtained in the measurement, and multiply the difference obtained by the number given in the "Value of one scale-division" column of the table. The result multiply by 100.

c) Subtract from the result, obtained under "a" , the number, obtained under "b". The result obtained is the measured frequency.

Example: The wavelength meter reading is 11.862. The frequency is to be found in the following way:

1) Find, from the calibration table, the next higher value of the wavelength reading, corresponding to the respective frequency. It is 12.083 and corresponds to the "Wavelength No" of 100 ( or to the frequency of 9,370 Mc/s).

2) Subtract from the wavelength meter reading, found in the table, the reading obtained with the measurement. Thus 12.083-11.862= 0.221.

3) The difference obtained multiply by the number, given in the "Value of one scale-division" in the table (0,73 Mc/s), and by 100. Thus

0,221 x 0,73 x 100 = 16.133 Mc/s

4) Subtract the number obtained in operation "3" from the frequency corresponding to the wavelength of No. 100 ( operation 1) and find the measured frequency:
9.370 Mc/s - 16.133 Mc/s = 9,353.867 Mc/s or approximately 9.354 Mc/s.
If the 31 IM meter is connected to the radar bomb sight transmitter as shown in Fig.20 , the measurement is done in the same way. With such measurement it is necessary that the r.f. power output, to be measured with the 31 IM instrument, be not smaller than 0,5 mW,

B. Measurement of the operational frequency of the transmitter with the wavelength-meter, type 35 IM.

1) Install the wavelength meter 35 IM at a distance of approximately 5 meters from the antenna of the radar bomb sight equipment and connect the horn antenna to the waveguide output of the wavelength meter.
2) Install the wavelength meter so that the broad side of the horn antenna is in the vertical plane and aims to the antenna of the radar bomb sight.
3) Turn the "Attenuation" control knob of the meter in clockwise direction to its extreme value ( the hoghest attenuation of the attenuator in the instrument) and set the "Oscilloscope-Meter" switch on the instrument to position "Meter".
4) Set the "Range in km" switch on the panel of the timer and control unit to position "100" and switch in the high voltage of the transmitter.
5) Decrease the attenuation of the attenuator of the instrument by [illegible]ning the "Attenuation" control knob in anti-clockwise [illegible]n until the pointer of the meter of the front panel of the instrument deflects approximately 8 ÷ 10 scale-divisions. If with the turning of the "Attenuation" control knob the indication of the meter, after at[illegible] certain value does not

increase with further decreasing of the attenuation, or if the indicated value even decreases, the detector of the wavelength meter is "Saturated"; if the attenuation is further decreased, the detector may be damaged. Hence if the detector is in the " saturation" state, the attenuation should be again increased to a level at which the indication of the meter is by 2- 3 scale-divisions lower in reference to the indication with the "saturation" of the detector.

If difficulties arise with this measurement ( the pointer of the meter deflects from its zero position only by 2-3 scale-divisions), the "Detector tuning" control knob should be adjusted to tune the detector cell in the instrument according to the maximum indication of the instrument pointer. If even under such conditions the indication of the meter is not sufficient, the detector should be replaced by another which is able to produce the necessary deflection of 8-12 scale-divisions after the detector cell is tuned and the depth of the detector probe adjusted.

6) Turn the control knob of the instrument 35 IM until the indication of the pointer decreases abruptly. Now turn the control knob slightly to the right and left side to obtain a minimum deflection of the pointer ( the wavelength meter is still tuned to the measured frequency). Write down the indication of the wavelength-meter scale.

7) Now turn again the control knob of the wavelength-meter until the next minimum in the indication of the meter is obtained, and write down the indication on the meter scale.

The difference between the two indications, measured as described under Items 6 and 7 is equal to the half of the wavelength of the radar bomb sight transmitter. Multiply the result obtained by two and you will get the length of the wave radiated by the transmitter.

Repeat the measurement two or three times. By means of the charts, enclosed in the papers of the 35 IM instrument, the wavelength obtained can be converted to frequency.

With the measurement, the synchroscope type 35 I can be used as indication instrument. For such measurement all the operations should be performed as described with the measurement of the

pulse length. The position in which the wavelength meter is tuned to the frequency of the transmitter corresponds to the minimum amplitude of the pulse on the screen of the synchroscope. The wavelength is calculated in the same way as described under Items 6 and 7.

c. Measurement of the operational frequency of the transmitter with the checking resonator type 50 I.

1) Install the checking resonator at a distance of 5-6 meters from the antenna of the radar bomb sight and connect the twist waveguide joint with the horn antenna to its waveguide output.
2) Install the horn antenna of the 50 I equipment and the antenna of the radar bomb sight in such a way that the radiation maximum of the radar bomb sight antenna aims towards the horn antenna 50 I.
3) Turn the "Tuning" control knob of the 50 I instrument within the limits of 25 and 29 great scale-divisions until the pointer of the microamperometer on the front panel of the instrument indicates a maximum deflection ( the control knob of the attenuator should be turned in anti-clockwise direction to its extreme position).
4) Read from the "Tuning" scale of the instrument the indicated value corresponding to the maximum deflection of the microamperometer pointer.
5) Find the operational frequency of the transmitter from the charts in the papers of the checking resonator.

§ 26. Measurement of the sensitivity of the receiver.

The sensitivity of a radar receiver is defined as the minimum power of the signal which is still observable above the level of the noise on the screen of the monitoring tube. The sensitivity is usualy expressed in decibels in reference to a level of 1 mW, i.e. by the value of attenuation of a 1mW signal.
Example: If the sensitivity of the receiver is 90 db as referred to the power of 1 mW, this is to say that a signal of 1 mW power, attenuated by 90 db ( i.e. by thousand million times), and fed to the input of the receiver after this attenuation is still presented on the screen of the monitoring tube on the background of the receiver noise.

The sensitivity measurement is performed by means of the generator type 31 IM, or the standard signal generator type 43I. In the following section the methods used in the measurement of the receiver sensitivity with the instruments is described.

A. Measurement of the receiver sensitivity with the signal generator type 31 IM.

The measurement of the receiver sensitivity with signal generator type 31 IM may be performed both on the stand in a repair shop, or aboard the aircraft-plane in the following way:

1) Disconnect the power-supply of the radar bomb sight equipment and dismount the waveguide from the transmitter and the antenna of the equipment.
2) Connect, by means of waveguide joints, the waveguide output of the transmitter with the signal generator. If the measurement is done in the repair shop, use the arrangement according to Fig.25 , and with the airborne equipment use the method presented in Fig.26.

With the measurement in the repair-shop ( fig.25) disconnect the cable "44" from the Šr-11-44 connector, and with the measurement aboard the aircraft (Fig.26) disconnect the cable "44" from the Šr-11-44 receptacle on the timer and control unit.

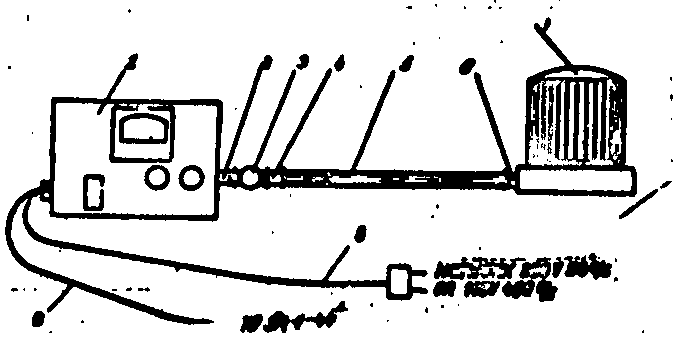

Fig. 25: Connection of the radar bomb sight transmitter with the signal generator in the receiver sensitivity measurement in the repair shop:
1 - signal generator type 31 IM
2 - waveguide output of the signal generator 31 IM
3 - suplementary attenuator of the instrument 31 IM

4 - waveguide joint with two flat flanges
5 - flexible waveguide
6 - waveguide output of the transmitter
7 - transmitter of the radar bomb sight equipment
8 - power-supply cable of the instrument 31 IM
9 - "44" cable

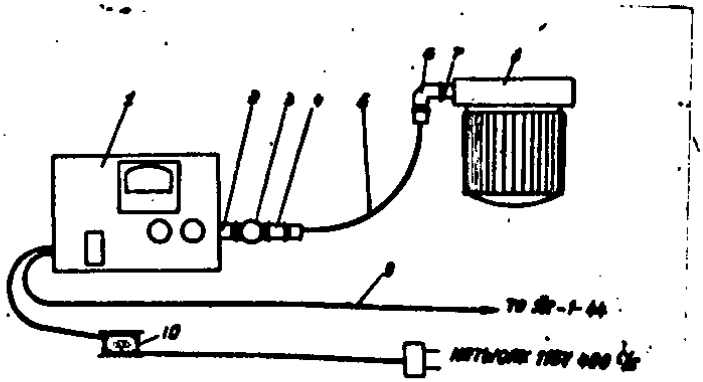

Fig. 26 - Connection of the radar bomb sight transmitter with the signal generator in the receiver sensitivity measurement aboard the aircraft:
1 - signal generator 31 IM
2 - waveguide output of the signal generator
3 - supplementary attenuator 31 IM
4 - waveguide joint with two flat flanges
5 - waveguide to waveguide coaxial joint
6 - corner waveguide joint
7 - waveguide output of the transmitter
8 - transmitter of the radar bomb sight
9 - coaxial cable from the accessories of the 31 IM meter
10 - drum with the power-supply cable

The "44" cable ( Item 9 , fig.26), or the coaxial cable from the accessories of the 31 IM, connected to the Šr-11-44 on the timer and control unit ( Fig.25) should not be for the present time connected to the Šr-2 on the signal generator.

3) Set the controls of the signal generator in their following positions:
power supply switch to position "Off",
"Type of operation" to position "Continuous 1"

"Instrument" to position "Control"
" 1mW-0,5mW" to position "1 mW"
"Generator" to position "Off"

4) Switch in the power supply of the signal generator by setting "On-Off" switch to position "On" ( if the instrument is energized from a 115 V 400 c.p.s. mains, the power supply of the radar bomb sight should be switched in prior to the supply of the signal generator).

5) after 4-5 minutes the signal generator should be calubrated as [illegible]curency of its power output meter ( see § 24, Item 4).

[illegible] "Generator" switch on the signal generator to position[illegible] the "Frequency-continuous" control knob to obtain the [illegible]utput of the klystron of the signal generator 31 IM ( the pinter[illegible] the output meter should indicate a maximum). If the pointer of this meter is deflected to the extreme right of the scale, or, on the other hand, if the indication does not exceed 0.1-0,5 mW, the "Power- output" control should be adjusted to obtain an output of 0.5 to 1,5 mW.

7) Tune the klystron generator 31 IM of the instrument to the frequency of the transmitter magnetron on this way:

a) Measure the frequency of the klystron generator in the instrument by turning the "Frequency" control knob of the signal generator to obtain a minimum of the power output indicator. Note the indication on the scale of the wavelength-meter ( the measurement of frequency is described more fully in § 25, A).

b) Turn the "Frequency" control knob to tune the wavelength-meter to the magnetron frequency of the transmitter ( this frequency was measured previously, see § 25,A).

c) Turn the "Frequency by steps" control knob to obtain an abrupt decrease of the indication on the power output meter. If the frequency indicated on the scale of the wavelength-meter ( i.e. the frequency of the magnetron) is higher as compared with the previously tuned frequency of the klystron in the signal generator, turn the control knob in clockwise direction; if the frequency of the transmitter magnetron is lower then that of the klystron, turn the control in anti-clockwise direction.

Repeat the tuning of the "Frequency" control within small limits near the respective position and check the coincidence of the decrease in the indicated values on the power output meter with the tuning of the wavelength-meter. If in this tuning the indication of the power output meter increases, the klystron is tuned to the correct frequency. If no, turn the "Frequency-Continuous" control knob to bring the pointer of the power output meter to a position where a maximum deflection to the right is obtained, and repeat the tuning of the "frequency in steps" control knob. Then correct the klystron tuning with the "Frequency-continuous" control. After the resonance is obtained, detune the "Frequency" control of the wavelength-meter by several revolutions.

8) Set the switches on the timer and control unit to their following positions:
   " Tube switch" to position "1"
   " Calibration marking" to position "Off"
   " Manual-Automatic" to position "Manual"
   " Detector current"- Power supply check" to position " Detector current"
   " Antenna control On-Off" to position "Off"
   " Range delay" to position "0"
   " Range in km" to position "100"

   The "R.f. gain" control knob should be turned in clockwise direction to its extreme position.

9) Switch in the power-supply of the radar bomb sight equipment by setting the "Mains 27 V - 115 V" and "Transmitter heating" switches to the position "On".

10) Set the "Generator" switch on the signal generator to position "Off" and check the calibration of the power output meter. If necessary, repeat the adjustement as described under § 24,A, Item 4.

11) Set the "Generator" switch to position "On" and turn the "Power" control knob on the signal generator to bring the pointer of the power output meter to the 1mW reference mark.

12) Connect the "44" cable or another cable from the accessories of the signal generator used instead of it to the Sr-11-44 recep-

tacle of the timer and control unit and the Sr-2 receptacle on the signal generator.

13) Adjust, on each of the two attenuators in the signal generator, an attenuation of 30 db ( use the calibration charts from the 31 IM equipment). The third supplementary attenuator should be set to zero attenuation reference.

14) Turn the "Receiver tuning" control knob to obtain a display of the pulse on the screen of the monitoring tube ( Fig.27,a)

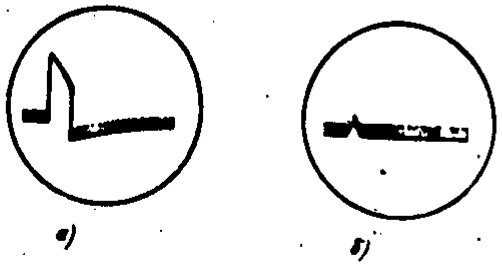


Fig. 27: - Display on the screen of the monitoring tube with the measurement of the receiver sensitivity:
a - display, with 60 db attenuation
b - display with 80 db attenuation

15) Turn the control knob of the supplementary attenuator to decrease the height of the pulse on the screen of the monitoring tube, and, at the same time, slightly turn the "Receiver tuning" control knob so that with a given attenuation the maximum height of the pulse display is obtained. Repeat the adjustment of the supplementary attenuation control until the pulse display begins to disappear in the noise background ( if the "receiver tuning" control is turned, the displacement of the pulse is no more visible on the noise background).

16) Note the indication of the three attenuators and convert it, by means of the respective charts, to decibels.

17) Calculate the sensitivity of the receiver as the sum of the decibel values of the three attenuators and the waveguide to waveguide coaxial joint ( given in the papers of the signal generator) The receiver sensitivity should be at least 90 db

18) Switch off the power supply of the radar bomb sight equipment and the signal generator 31 IM.

B. Measurement of the receiver sensitivity with the standard signal generator , type 43 I.

The measurement of the receiver sensitivity with the standard signal generator 43 I can be done only in the workshop. The measurement is done as follows:

1) Connect , by means of waveguide joints, the waveguide output of the transmitter and the waveguide output of the standard signal generator according to fig .28.

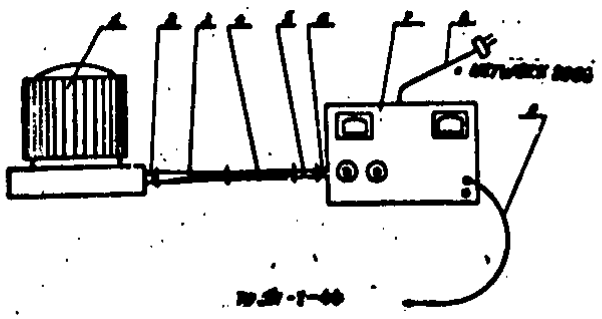

Fig. 28:- Arrangement of the apparatus ( standard signal generator, type 43 I) with the measurement of the receiver sensitivity:

1 - transmitter of the radar bomb sight
2 - waveguide output of the transmitter
3 - twist waveguide joint
4 - flexible waveguide
5 - waveguide joint with two flat flanges
6 - waveguide output of the generator
7 - standard signal generator 43 I
8 - power-supply cable of the generator
9 - cable "44" of the radar bomb sight equipment

2) Disconnect the "44" cable from the Sr-11-44 of the transmitter and connect it to the "External control" receptacle of the standard signal generator.

3) Set the switches on the generator to following positions:
"Main switch" to position "Off"
"Pulse length" to position "10 microsec."

"Polarity of the control pulse" to position " "
"Operation-Lock" to position "Lock"

The "Attenuation db/mW" control knob of the right attenuator set to position "45 db", and of the left to " 25-30 db". The "Delay" control knob set to the medium position.

4) Set the switches on the radar bomb sight to following positions:
" Tube switch" to position "1"
" Calibration marking" to position "Off"
" Manual- Automatic" position "Manual"
" Antenna control On - Off" to position "Off"
" Detector current- Power -supply check" to position " Detector current"
" Range delay x 10 km" to position "0"
" Range in km" to position "100"
" Operation-Calibration" to position "Operation"

The "R.f. gain" control knob turn in clockwise direction to its extreme position.

5) Connect the power supply cable of the generator to the 220 V 50 c.p.s. mains and set the "Main switch" to position "Continuous wave". Let the instrument heat for 10-15 minutes.

6) Set the "Operation-Lock" switch to position "Operation" and balance the thermistor bridge in this way":
a) Turn the "Repeller voltage" control knob in anti-clockwise direction to its extreme position and turn the "Zero adjustment" control knob to get the pointer to the zero reference mark.
b) Turn the "Repeller voltage" control knob in clockwise direction and check the stability of the pointer in all positions of the "Repeller voltage" control ( the pointer must not deflect to the left from the zero). If necessary, adjust the "Repeller voltage" control to bring the pointer of the meter to the extreme left position ( left-side from the zero reference) and then turn the "Zero adjustment" control knob to return the pointer to zero.

7) Turn the "Repeller voltage" control knob to obtain the maximum indication of the pointer of the power output meter with the operation of the klystron in the medium zone of oscillation.

N o t e : In the course of turning the "repeller voltage" control knob from one extreme position to the other, the power output meter will indicate approximately three maxima, each of which corresponds to one of the oscillation zones of the klystron. In the measurement with the standard signal generator 43 I usually the medium zone of oscillation is used.

The indication of the generator voltmeter 43 I should be approximately 1000V, the power output should be about 0,8 to 1,2 mW. If the power output is higher or lower than this value, the "Coupling" control knob should be turned to obtain an output of approximately 1 mW.

8) Adjust the frequency of the klystron 43 I equal to that of the transmitter magnetron. The method used is this:
   a) Measure the frequency of the klystron, tuned in the course of the preceeding operations ( by turning the "Wavelength-meter" control knob). Note the indication of the wavelength meter scale.
   b) Use the calibrated charts of the wavelength-meter and convert thetransmitter magnetron frequency ( measured as per § 25) to the scale-divisions of the wavelength-meter of the 43 I.
   c) Turn the "Wavelength-meter" control knob to obtain an indication on the scale of the wavelength meter equal to the frequency of the transmitter magnetron.
   d) Turn the "Frequency" control knob of the generator and tune the klystron to the frequency to which the wavelength meter was previously tuned.
   If the previously tuned frequency ofthe klystron is higher than that of the magnetron, turn the "Frequency" control knob of the generator 43 I in clockwise direction. If the klystron frequany is lower than that of the magnetron, turn the respective control knob in anti-clockwise direction.
   In the position where the klystron is tuned to the magnotron frequency, the indication of the power output meter decreases to a minimum. After the klystron is tuned to the frequency of the magnetron, detune the "Wavelength-meter" control knob by 2-3 revolutions.
9) Alternatively turn the left and right "Tuning" control knobs of the generator to obtain a maximum deflection of the pointer

of the power-output meter.

10) Switch in the power-supply of the radar bomb equipment ( set the "Mains 27 V-115V" and "Transmitter heating" switches to position "On").

11) Inspect the balance of the thermistor bridge of the power output meter by turning the "Repeller voltage" control knob in anti-clockwise direction until a maximum decrease of the power output meter is obtained. If the bridge is correctly balanced, this position should correspond to the zero reference of the power meter scale. If no, bring the pointer to the zero reference by turning the "Zero adjustment" control knob.

12) Turn the "Repeller voltage" control knob of the generator 43 I to bring the pointer of the power output meter to a position, corresponding to the maximum indication of the power output meter in the medium zone of oscillation of the klystron ( the indication on the scale of the voltmeter 43 I should be approximately 100V).

13) Set the "Main switch" to position "Pulse operation" and turn the "Receiver tuning" control knob on the timer and control unit of the radar bomb sight to obtain a maximum height of the negative pulse on the screen of the monitoring tube of the radar bomb sight ( see Fig.29 a).

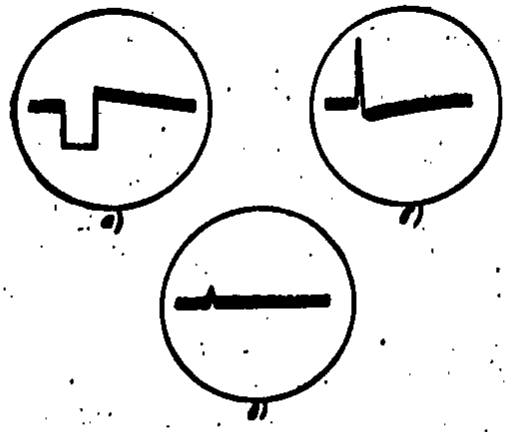

Figure 29.

Fig. 29i- Display on the screen of the monitoring tube with measurement of the receiver sensitivity:
a - negative pulse of 10 microsec., attenuation 70 db
b - positive pulse of 1 microsec., attenuation 70 db
c - positive pulse of 1 microsec., attenuation 80 db.

14) Adjust the "Coupling" control knob on the generator 43 I panel to bring the pointer of the power output meter 43 I to the 1mW reference mark.
15) Set the "Pulse lungth" switch to the position " 1 microsec." and turn the "Repeller voltage" control knob in clockwise direction ( i.e. increase the voltage on the repeller electrode of the klystron by 16-22V), until a narrow positive pulse is presented on the screen of the monitoring tube of the radar bomb sight ( see Fig.29b). Turn the "Repeller voltage" control knob to obtain the maximum height of this pulse.
16) By means of the "Delay" control knob on the generator 43 I panel bring the positive pulse to a distance of approximately 5 to 10 mm from the beginning of the sweep trace on the monitoring tube of the radar bomb sight.
17) Turn the control knob of the left attenuator in clockwise direction ( increasing the attenuation) until the positive pulse disappears in the noise background onnthe screen of the monitoring tube. ( if the "Delay" control knob of the generator is turned, the displacement of the pulse is not visible on the noise background).
18) Read the indication from the scale of both attenuators and use the calibration charts of the generator to introduce the correction for the respective frequency. The sum of the attenuation of both attenuators expresses the sensitivity of the receiver; it should be at least 90 db.
19) Switch off the power supply of the radar bomb sight equipment and the standard signal generator.

## § 27. Measurement of the travelling ( standing) wave ratio in the antenna and waveguide system

The travelling ( standing) wave ratio expresses the quality of the matching of individual elements of the waveguide and antenna system.

If the matching is poor, the standing wave ratio (SWR) is high and the radiation of the transmitter power output is small, the sensitivity of the receiver is low and the magnetron operation is disturbed.

The standing wave ratio is expressed by this formula:

$$k = \frac{U_{max}}{U_{min}}$$

where $U_{max}$ and $U_{min}$ are the maximum and minimum values of the voltage on the line, respectively. The travelling wave ratio is a value, reciprocal to the standing wave ratio.

The standing or travelling wave ratio, respectively, may be measured in the following way:

1) with the standing wave ratio meter, type 60 I
2) with the slotted of section type 33 I

The SWR meter, type 60 I may be inserted directly into the waveguide chain of the transmitter and antenna, using directly the radar transmitter as a.f. source. No other apparatus is necessary in this measurement.

If the slotted section, type 33 I is used for the measurement of the travelling wave ratio, the signal generators type 43 I or 51 I and the three stage amplifier type 28 I must be used. The standing wave ratio may be measured only on the stand.

a. Measurement of the standing wave ratio with the 60 I SWR meter

1) Disconnect the waveguide from the radar bomb sight transmitter. The waveguide has to be connected to the antenna in the same position as with the airborne operation.
2) Connect the 60 I meter with the minimum necessary number of waveguide joints between the transmitter and the waveguide of the radar bomb sight antenna.

The arrangement of the apparatus is shown in Fig.30.

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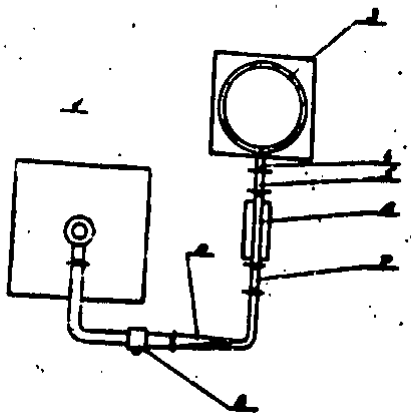

Fig. 30:- Arrangement of the apparatus ( SWR meter type 60I) used with the measurement of the standing wave ratio of the antenna and waveguide chain of the radar bomb sight

1 - antenna of the radar bomb sight
2 - waveguide
3 - radar bomb sight transmitter
4 - waveguide output of the transmitter
5 - waveguide joint with two flat flanges
6 - standing wave ratio meter, type 60 I
7 - waveguide joint with two protective flanges
8 - phase shifter

The waveguide elements must be connect very carefully and the instructions of the Chapter IV, § 2 have to be respected.

3) Switch in the power supply of the radar bomb sight.
4) Set the "Meter-Amplifier" switch of the SWR meter to position "Meter" and the waveguide switch marked "Reflected power-Direct power" set to its extreme upper position ( "Reflected power"). The control knobs of the SwR meter attenuators should be set in their extreme position ( 100th scale division).
5) Set the "Range in km" switch on the timer and control unit to position "100" and switch in the high voltage of the transmitter.
6) Turn in anti-clockwise direction the control knob of the lower attenuator until the pointer of the microamperemeter on the front panel of the SWR-meter deflects to the 10th scale-division.

Further increase of this meter should not be attempted, as the detector may be "saturated" ( see §25, Item 5).
With too low indication of the microamperemeter tune the detector cell of the SWR-meter by changing the depth of the detector probe and by turning the "Detector tuning" screw until the maximum indication of the microamperemeter is obtained.

7) Set The "Reflected power-Direct power" switch to its extreme lower position ("Direct power") and turn the control knob of the upper attenuator to bring the pointer of the microamperemeter to a position in which it was with the measurement described in Item 6 ( 10th-scale-division).
8) Read from the scale of the upper attenuator the standing wave ratio, which should not exceed the value of 1,43.
9) Turn manually the antenna of the radar bomb sight in steps of 30 degrees and each time check the standing wave ratio. In no point should the standing wave ratio exceed the value of 1,43.
10) Adjust the antenna to the position in which the standing wave ratio has its maximum value and vary the tilt angle of the antenna in steps of 5 degrees. In all positions the standing wave ratio should not exceed the value of 1,43. The difference between the maximum and minimum values of the SWR should not surpass 6% of the maximum SWR values.
11) If the standing wave ratio is over 1,43, the phase shifter installed in the radar bomb sight waveguide may be used to decrease it. Set the "Direct power-Reflected power" switch to position "Reflected power" and turn carefully ( not to damage the surface of the waveguide) the head of the phase shifter screw ( with a 11 mm spanner) within the limits of one revolution in both directions, until the minimum indication of the microamperometer is obtained. Then repeat the measurement of the standing wave ratio.

In the measurement with the 60 I SWR meter the signal generator type 43 I or 51 I may be used as a r.f. source instead of the transmitter magnetron. Under such conditions the microamperemeter of the SWR-meter cannot be used as indicator, and the 28 I amplifier must be used. The measurement should be performed in the same way as described above. The only difference is the necessity of connection of the terminal marked " To the am-

plifier" to the input of the 28 I ( by means of a c50X1-HUM-le); also the "Meter-Amplifier" switch on the SWR-meter has to be set to position "Amplifier". Prior to the measurement all the operations described in § 27B,ITEM 3 to 8 should be performed to install the 43 I and 28 I instruments. Then the attenuation of the attenuators should be decreased to 5-8 db. The "Reflected power-direct power" switch is set in the position "Reflected power". The measurement is done by the same method as described above ( Items 6,7,8,9,10). The indications are read from the voltmeter of the 28 I amplifier, the pointer of which should be set to the 50th scale-division.

B- Measurement of the travelling wave ratio with the slotted section type 33 I.

With the measurement of the travelling wave ratio with the slotted section type 33 I the power r.f. is generated in the standard signal generator type 43 I ( also the signal generator 51 I may be used instead). The indications are read from the three-stage amplifier, type 28 I. The measurement method used is the following:

1) Disconnect the waveguide from the radar bomb sight transmitter
2) Connect the standard signal generator type 43 I with the slotted section, the waveguide and the antenna of the radar bomb sight. In connecting the assembly, rather bolts with nuts ( from the 43 I accessories) should be used, instead of holders. The arrangement of the apparatus used is shown in Fig.31.

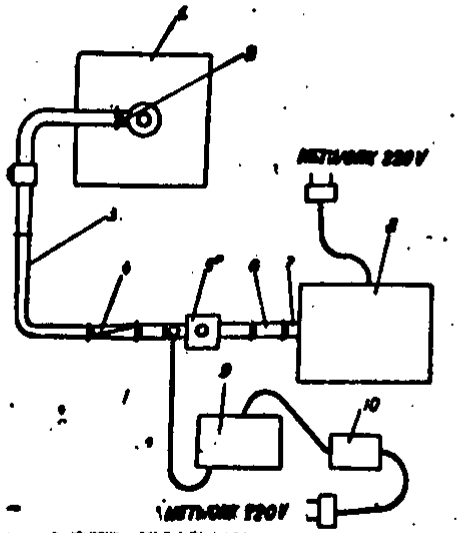

Fig. 11: - Arrangement of the apparatus used with the measurement of the travelling wave ratio:
1 - antenna of the radar bomb sight
2 - waveguide input of the radar bomb sight antenna
3 - waveguide of the radar bomb sight
4 - twist waveguide joint
5 - slotted section, type 33 I
6 - waveguide joint flat and protective flanges
7 - waveguide output of the 43 I
8 - standard signal generator, type 43 I
9 - amplifier, type 28 I
10 - magnetic voltage stabilizer for the 28 I amplifier
11 - coaxial cable 33 I

The coaxial cable from the detector cell of the 33 I should be connected to the receptacle "Input" of the 28 I.

3) Set the switches on the amplifier to the following positions:
"Mains" to position "Off"
" Crystal-Bolometer" to position "Crystal"
" Input voltage" to position "x1"
" Frequency range" to position "1,000-2,500"
" Attenuation" to position "1:1"
" Voltmeter" to position "Off"
The "Continuous adjustment of the frequency" control knob should now be turned in clockwise direction to its extreme position. Turn the "Gain" control knob in anti-clockwise direction to its extreme position.

4) Set the switches on the 43 I to the following positions:
"Main switch" to position "Off"
" Pulse length" to position "100 microsec."
" Polarity of the trigger pulse" to position "Internal control"
" Operation-Lock" to position "Lock"
The "Attenuation" control knob of the attenuators should be turned in anticlockwise direction to their extreme positions.

5) Switch in the power-supply of the signal generator 43 I by setting the "Main switch" to position "Continuous wave". Switch on the 28 I amplifier by setting the "Mains" switch to position "On".

6) After 4-5 minutes set the "Operation-Lock" switch to position "Operation" and balance the thermistor bridge of the 43 I ( see also § 26 B. Item 6). 50X1-HUM

7) Adjust the frequency of the klystron in the 43 I instrument to the frequency of the transmitter magnetron ( see also § 26 B, Items 7, 8 and 9).

8) Adjust the "Coupling " control to a power output of approximately 1 - 1,2 mW.

9) Switch in the power-supply of the 28 I and, by turning the "Zero adjustement" control knob set the pointer of the voltmeter in the 28 I to the zero reference. Set the "Voltmeter" switch to position "On".

10) Set the "Main switch" on the 43 I to position "Pulse operation".

11) Set the left attenuator of the 43 I to zero, and use the right one for decreasing the attenuation to such a level, at which the pointer of the voltmeter in the amplifier 28 I is within the limits of 60th and 80th scale divisions. The indication on the left attenuator should be approximately 15 to 20 db. If with the decrease of the attenuation the indication of the 28 I voltmeter does not increase, or if the indication required is obtained with a considerable lower attenuation, the performan of the detector in the slotted section should be inspected, or if the detector is found correct, the detector cell of the slotted section should be tuned.

12) Turn the handle of the slotted section and shift the probe until the maximum indication of the amplifier meter is obtained.

13) Turn the control knob of the left attenuator on the 43 I to the right and left to bring the pointer of the 28 I meter to the 100th ( or 50th) scale-division. In this position the maximum voltage ($U_{max}$) is indicated.

14) Turn the handle of the slotted section and shift the probe along the line until a minimum voltage is obtained as indicated by the pointer of the amplifier meter. Note the indication on the upper scale of this meter ($U_{min}$).

15) Calculate the value of the travelling wave ratio from the following formula:

$$K = \sqrt{\frac{U_{min}}{U_{max}}} \cdot 100\%$$

where: k= travelling wave ratio in %

$U_{min}$ = minimum indication of the meter 28 I

$U_{max}$ = maximum indication of the meter 28 I

16) Turn the antenna in steps of 30° and measure the respective travelling wave ratio in each of the respective positions.

17) Set the antenna to a position where the minimum travelling wave ratio is measuesured and inspect the ratio while tilting the antenna in steps of 5 degrees from -5° to -20°.
In all the tilt angle positions the travelling wave ratio should be at least 70%. If necessary, re-adjust the phase shifter, as explained in § 27a, Item 10.
The difference between the maximum and minimum values of the travelling wave ratio should not exceed 5%.

## § 28. Determination of the pass band on the intermediate frequency amplifier of the receiver with the VHF signal generator, type SG-1 and the volt-ohm-meter, type VK 2.

The measurement may be done only on the stand, and prior to the measurement of the receiver sensitivity. The measurement should be done in the following sequence:

1) Remove the lower cover from the radar bomb sight transmitter and take out the detector-holder with the detector from the mixer cell of the receiver r.f. head. Install the detector equivalent instead of the detector.
2) Connect the detector equivalent to the output of the signal generator with a r.f. cable.
3) Use conductors for connecting the "V" receptacle of the VK-2 voltmeter with the pin No.3 of the L206 tube ( 6X6C) and the "Ground" receptacle of the VK-2 with the chassis of the radar bomb sight equipment.
4) Set the switches on the signal generator to following position:
" Modulation" to position "Off"
" Pulse- Continuous operation" to position "Continuous"
5) Switch in the power-supply of the signal generator and turn the "Carrier" control knob to bring the pointer of the carrier frequency voltage indicator to the 100th scale-division. In further measurement care should be taken that the pointer of this meter

is always in this position. According to the circular dial of the signal generator, marked "Output", adjust an output voltage of 100 microvolts.

6) Switch in the power-supply of the VK-2 and set the voltage-range switch to position 3 V. Use the "Zero adjustment" control knob to bring the pointer of the meter to zero reference of the scale.
7) Switch in the power-supply of the radar bomb sight. Set the "R.f. gain" control knob to its medium position.
8) Tune the signal generator to approximatively 30 Mc/s and check from the deflection of the pointer, the passing of the signal through the receiver.
9) Switch off the power supply of the signal generator and use the "R.f.gain" control on the timer and control unit to adjust the receiver noise voltage to 0.3V ( use the 3V scale of the VK-2).
10) Switch in the power-supply of the signal generator and adjust the "Carrier" control to obtain a deflection of the pointer to the 100th scale-division.
11) Turn slightly the tuning control knob of the signal generator to obtain a maximum deflection of the pointer of the VK-2 meter.
12) By turning the "Output" control knob vary the output voltage of the signal generator to obtain an indication of 1,5 V on the scale of the VK-2 meter.
13) Measure the frequency response curve of the intermediate frequency amplifier of the radar bomb sight receiver. Tune the signal generator successively to the following frequencies: 27, 28, 29, 29,5, 30, 30,5, 31, 32, 33 and 34 Mc/s, and at each frequency write down the voltage indicated by the VK-2 voltmeter.
14) From theresults of this measurement draw the respective frequency response curve of the intermediate frequency amplifier according to Fig.32.
15) Calculate the pass band of the intermediate frequency amplifier ( $F_{np}$) as the difference between the two frequencies ( $f_1$ and $f_2$) found on the frequency response curve at the level of 0.7 of the peak value of the curve ( see Fig.32).
The pass-band must be at least 3.8 Mc/s.

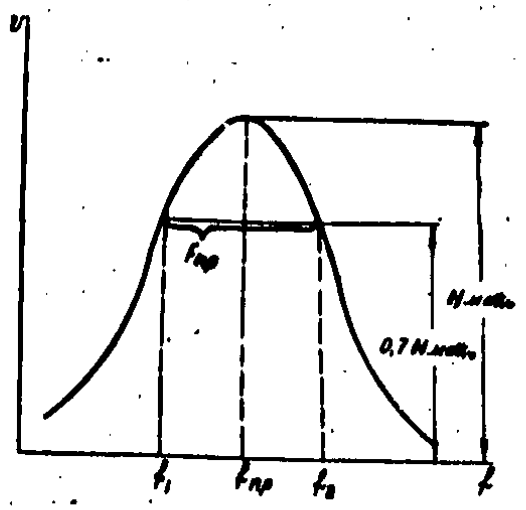


Fig. 32: Frequency response curve of the intermediate frequency amplifier of the radar bomb sight receiver.

N o t e : In the course of the measurement, constant value of the supply voltage ( 115 V) must be maintained and also the voltage of the carrier frequency produced by the signal generator must be kept constant ( 100th scale-division of the meter).

16) Calculate the intermediate frequency of the receiver from the equation

$$f_{np} = \frac{f_1 + F_2}{2}$$

where: $f_{np}$ = the intermediate frequency of the receiver ( in Mc/s)

$f_1$ and $f_2$ = the frequencies corresponding to the 0,7 value of the peak voltage ( in Mc/s).

The intermediate frequency should be $30^{\pm}$ Mc/s.

17) Switch off the power supply of all the equipment and disconnect both instruments from the radar bomb sight. Replace the detector holder with the detector and adjust the detector current value by means of the meter installed on the panel of the timer and control unit. Check the operation of the receiver by means of the checking resonator 50 I and, if necessary, tune the receiver as described in Chapter II,§3.

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29. Inspection of the peak voltage of the pulse at which the firing of the transmitter occurs. Inspection of the discharge voltage of the transmitter with the pulse generator type 26 I.

1) Disconnect the "44" cable from the Šr-11-44 receptacle on the transmitter unit and connect it to the "External synchronization" receptacle of the 26 I. Use the coaxial cable for connecting the "Output" receptacle on the 26 I, marked " " with the Šr-11-44 receptacle on the transmitter.
Connect the "Ground" receptacle on the 26 I with the chassis of the transmitter unit. The arrangement is shown in Fig.33.

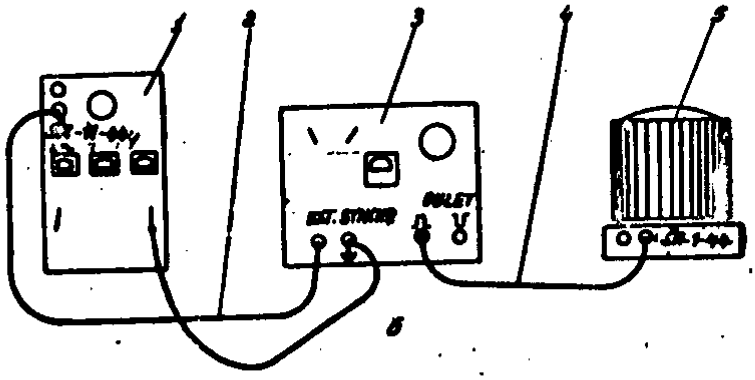


Fig. 33: - Arrangement of the connection of the pulse generator 26 I with the transmitter of the radar bomb sight:
1 - timer and control unit of the radar bomb sight
2 - coaxial cable from the Šr-1-44 receptacle on the timer and control unit to the "External synchronization" receptacle of the pulse generator
3 - pulse generator
4 - coaxial cable from the "Output " receptacle of the pulse generator to the Šr-1-44 receptacle
5 - transmitter of the radar bomb sight
6 - conductor from the chassis of the radar bomb sight to the "Ground" receptacle on the pulse generator

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2) Set the switches on the pulse generator 26 I to the following positions:
" Pulse lenght" to position : 1 microsec"
" Delay" to position " 1 microsec."
" Pulse: External-Generator" to position "Generator"
" Range" to position " x 10"
" Recurrence frequency " to position "External control"
" Calibrator" to position "Off"
" Output switch" to position "Ω"
" Sweep" to position "Fast"
" Mains" to position "Off"
" Anode" to position "Off"
" Delay line" to position "On"
" External synchronization" to position "⊥"
Adjust the "Sweep amplitude" control to its medium position, turn the "Pulse amplitude" control knob in clockwise direction to its extreme position.

3) Set the switches of the timer and control unit of the radar bomb seight to the following positions:
" Tube switch" to position "2"
" Calibration marking" to position "Off"
" Manual- Automatic" to position "Manual"
" Antenna control: On-Off" to position "Off"
" Detector current- Power supply check" to position "Power supply check"
"Range delay x 10 km" to position "0"
"Range in km" to position " 10/60"
"Mains 27V-115" to position "Off"
"Transmitter heating" to position "Off"

4) Switch in the power supply of the radar bomb sight and set the "Mains 27V-115V" and the "Transmitter heating" switches to position "On".

5) Set the "Mains" s itch on the pulse generator to position "On", and after some 1 - 2 minutes set the "Anode" switch to position "On."

6) Use the "Brigthness" and "Focus" controls of the pulse generator for adjustment of the convenient brightness and sharp focus of the display on the screen of the pulse generator tube.

7) Five minutes after the switching on of the "Transmitter heating" switch on the timer and control unit switch in the high voltage of the transmitter.
Inspect the performance of the transmitter from the indication of the "Magnetron current" meter and the monitoring tube. The value of the magnetron current in the 10-60 range should be 7 to 8 ma, in the "100" or "200" ranges 10 ma, and in the "Beacon" operation 9 - 12 ma. The display of the modulator pulse on the screen of the monitoring tube of the radar bomb sight should not be covered by the sweep base trace, and it should not be doubled ( see Fig.34 a).

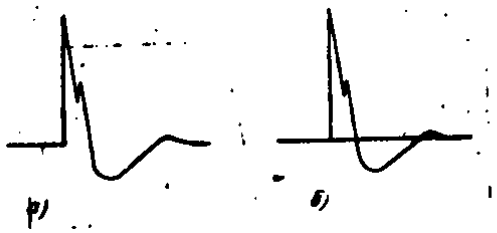


Fig. 34: - Display of the modulator pulse on the screen of the monitoring tube of the radar bomb sight:
a - with standard operational conditions
b - with irregular modulator pulse

8) Decrease the voltage of the transmitter trigger pulse by turning the "pulse amplitude" control knob of the pulse generator in anti-clockwise direction until the display of the modulator pulse on the screen of the monitoring tube is crossed by the sweep base trace ( see Fig.34 B) The "Pulse amplitude" control knob should not touched afterwards. In this situation switch off the high voltage of the transmitter and cut off and on the "Transmitter heating" switch.
9) Measure the peak value of the transmitter trigger pulse voltage by this method:
a) turn the "Vertical displacement" control knob of the pulse generator to obtain the coincidence of the base of the pulse ( viz. the sweep base trace) with the thick line on the

screen of the pulse generator tube. Note the indication of the voltmeter on the front panel of the generator.

b) turn the "Vertical displacement" control knob to obtain the coincidence of the pulse peak with the line to which the sweep base trace was previously displaced, and note the indication of the voltmeter of the pulse generator.

c) measure the peak value of the transmitter trigger pulse expressed by the difference between the voltmeter indications with the measurements described under "a" and "b", respectively, the peak should exceed 90 V.

10) Inspect the peak voltage of the transmitter trigger pulse in "Scanning" operation with the "Range" swith in position "100" and in the "Beacon" operation.

11) Turn the "Pulse amplitude" control knob in clockwise direction to its extreme position and set the "Beacon-Scanning" switch to position "Scanning". Set the "Range" switch to position "100". Switch in the high voltage of the transmitter.

12) Inspect the discharge voltage of the transmitter with mounted cover and normal atmospheric pressure ( no compressed air inside the transmitter cover).
For this inspection the "anode" switch of the pulse generator should be set to position "Off" and after 60 seconds again to "On". The transmitter should operate reliably, the indications of the meter in both the "Magnetron current" and "Rectifier current" positions of the respective switch should be within the limits of the respective Technical Regulations.

13) Switch off the supply of the transmitter and the pulse generator.

## § 30. Inspection of the vertical and horizontal radiation patterns of the antenna.

The inspection of the antenna radiation patterns in both the horizontal and vertical planes should be done with the equipment installed on a rotable stand, where the antenna can be tilted without the necessity of the dismantling of the transmitter-antenna assembly. Thus the transmitter magnetron is used as the r.f. energy source with the measurement of the radiation patterns. The r.f. power radiated by the antenna is measured with the power output meter of the

watt and wavelength-meter, type 34 IM, or, if this instrument is not by hand, the signal generator, type 31 IM. However it should be said here that the measurement accuracy of the 31 IM instrument is inferior to that of the 34 IM type, as the indication of the power output meter of the 31 IM considerably suffers from the variations of the power supply voltage as well as the supplementary heating of the thermistor, caused by the temperature change inside the cover due to the heating of the components of the instrument. Thus, to obtain satisfactory results with the measurement by means of the 31 IM meter, the initial balance of the thermistor bridge ( zero adjustment) should be inspected periodically after each 2 - 3 minutes of the operation of the meter. The instrument should be in operation at least 30 minutes before the beginning of the measurement.

In addition to the above mentioned instruments, also the field-strenght indicator type 38 I with the 281 amplifier may be used.

4. Inspection of the radiation pattern of the radar bomb sight antenna with the signal generator, type 31 IM, or the watt- and wavelenght-meter, type 34 IM.

1) Install on the rotatable stand the special scales and pointer for the measurement of the radiation patterns of the antenna.
2) At a distance of 8 - 10 m install, on another stand, the horn antenna from the 31 IM or 34 IM accessories. The antenna should be placed in the plane of rotation of the radar bomb sight antenna. This installation is done by means of a cord and two markers on the base of the rotatable stand on which the transmitter and antenna assembly of the radar bomb sight equipment is installed. The horn antenna should be installed in such a way that its broad side is in the vertical plane. No obstacles should occur between the radar bomb sight antenna and the horn antenna, and also the space within the limits of the least 3 meters from the straight line intercesting the both antennas should be free. The distance from the antenna to the ceiling should be at least 2 meters. The arrangement of the antennas is shown in Fig.35.

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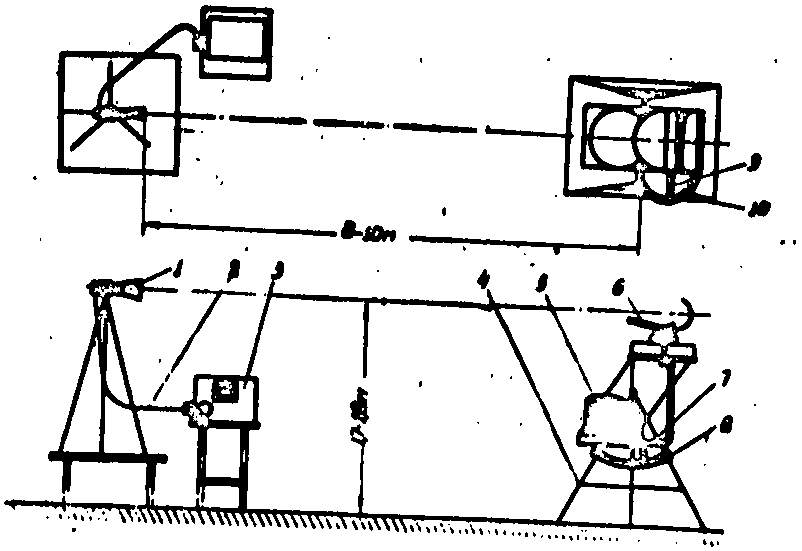

Fig. 35: - Arrangement of the apparatus ( 31 IM, 34 IM or 38 IM types) in the measurement of the radiation pattern of the radar bomb sight antenna

1 - horn antenna of the 31 IM or 34 IM
2 - waveguide to coaxial junction
3 - instrument type 31,IM or 34 IM
4 - stand of the transmitter and antenna assembly
5 - transmitter of the radar bomb sight unit
6 - antenna of the radar bomb sight unit
7 - pointer
8 - scale
9 - pointer
10- scale

3) Use the waveguide- to-coaxial junction for connecting the horn antenna with the respective instrument; 31 IM or 34 IM.
4) Adjust the signal generator 31 IM in this way:
   a) Set the switches on the signal generator to their following positions: "0,5 mW-1mW" to position "1mW"
   "Generator" to position "Off"
   "Type of operation" to position "Continuous 1"
   "Meter" to position "Stabilization"
   "Mains switch" to position "Off"

Turn the attenuator control knobs in the clockwise direction to their extreme positions.

b) Connect the power supply cable to a 220 V 50 c.p.s. or 115 V 400 c.p.s mains, and set the mains switch to position "On".

c) Use the "Measurement" switch to bring the pointer of the power output meter close to zero reference and let the instrument operate for 30 minutes.

d) After the instrument is heated calibrate the power-output meter, as described in § 24 A, Item 4.

In the course of the measurement inspect the zero adjustment of the pointer of the power output meter each 2 - 3 minutes.

If the watt-and wavelenght-meter type 34 IM is used for measurement, it should be adjusted in this way:

a) Set the operation type switch to position "On", and the "0,5mW - 1.0 mW" switch to position "1mW". Turn the control knob of the attenuator in clockwise direction to its extreme position.

b) Set the "Power-supply" switch to position "Internal", if the instrument is supplied from the inside battery, and to "External", if the instrument is energized from an external D.C. power source of 24 V ( accumulator battery).

c) Set the operation type switch to position " Supply stabilization". In this position the pointer of the power output meter should deflect to the 2.0 mW reference mark. If this is not so, turn the axle of the "Bridge supply stabilization" potentiometer accessible from the front panel of the instrument, to bring the pointer of the power output meter to the 2.0 mW reference.

d) Set the operation type switch to position " By-steps measurement" and turn the "Measurement" switch to bring the pointer of the power output meter to a position as close to the zero of the scale as possible. Note the position of the "Measurement" switch.

e) Set the operation type switch to position "Exact measurement" and use the "Zero adjustment" control to bring the pointer of the power output meter exactly to the zero reference of the scale.

f) Set the "Measuremet" switch to position higher by one step than the position in which the zero was adjusted. The pointer of the meter should deflect to the 1 mW reference mark. If this is not so, turn the "Sensitivity" control knob to adjust the pointer to the 1 mW reference. Then set the "Measurement" switch to a position lower by one step and inspect the adjustment of the pointer on the zero reference. If necessary, adjust the pointer. Then inspect the pointer in position 1 mW, if necessary, repeat the adjustment. The adjustment should be repeated until the pointer of the power output meter is deflected exactly to the respective references of 0 and 1mW on the scale with the switching of the "Measurement" control.

5) Set the "Mains 27 V-115 V" and "Transmitter heating" switches on the timer and control unit to position "On". The "Range in km" switch should be set to position "100". Press the "Up-Down" switch controlling the antenna position and adjust the zero antenna tilt angle from the scale of the antenna tilt indicator on the front panel of the timer and control unit. After 4-5 minutes cut on the high voltage of the transmitter.

6) Turn the control knobs of the attenuators in anti-clockwise direction to their extreme position. ( i.e. the minimum attenuation) and turn the antenna of the radar bomb sight in the horizontal plane until a maximum is indicated by the power output meter. With the progressive increasing of the indication of the power output meter, adjust the control knob of the attenuator in the clockwise direction so that the scale indication can be conveniently read.

7) Turn the antenna of the radar bomb sight in the vertical plane until the power output meter indicates a maximum. In this position the maximum of the antenna radiation is directed towards the horn antenna.

8) Measure the distance from the floor to the medium part of the reflector of the radar bomb sight antenna, and install the horn antenna of the 31 Im or 34 IM instrument at the same height (the height should be measured from the floor to the center of the waveguide output of the horn antenna) . Then slightly turn the horn antenna up and down and left and right to obtain a maximum indication of the power output meter.

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9) Turn slightly the antenna of the radar bomb sight and correct the position of radiation maximum of the radar bomb sight antenna in the vertical as well as horizontal directions. This maximum should aim towards the horn antenna ( if the radiation maximum of the radar bomb sight antenna coincides with the direction of the horn antenna, the power output meter indicates the maximum value).

10) Install a protractor on the upper surface of the segment of the radar bomb seight antenna and measure the tilt angle of the segment in reference to the horizontal plane; the angle should be about 7 - 8 degrees. This angle gives the tilt angle of the antenna segment in reference to the radiation maximum of the antenna, i.e. in the horizontal plane in this case. This angle must be measured to enable the adjustment of the antenna tilt indicator ( see also § 16 A. Item 2).

11) Loosen partly the screws fixing the angular scale of the antenna rotation in the azimuth plane and adjust the scale so that the visor of the pointer coincides with the zero reference mark on the scale. Then tighten the scale.

12) Loosen partly the screw fixing the pointer of the antenna tilt scale and adjust the pointer so that its visor coincides with the zero reference marker of the respective scale. Then tighten the pointer.

13) Turn the control knobs of the attenuators in clockwise direction to their extreme position ( i.e. maximum attenuation). The pointer of the power output meter should return to the zero reference of the scale. If this is not so, use the "Zero adjustment" control on the front panel of the 31 IM or 34 IM to adjust the pointer to zero. With further measurement the zero adjustment inspection should be repeated periodically after each 2- 3 minutes of operation of the 31 IM and after each 5-7 minutes of the 34 IM instrument.

14) Turn the control knobs of the attenuators until the indication on the power output meter is exactly 2 mW. The attenuation, introduced by both attenuators, should be 5-10 db under such circumstances ( with an attenuation of 7-9 db obtained in the waveguide-tocoaxial junction).

15) Measure the vertical radiation pattern of the antenna; turn the rotatable part of the stand with the installed antenna so that the segment part of the antenna is tilted forwards and down; this movement corresponds to the "Upwards" tilt of the airborne antenna. Tilt the antenna in steps of 2,5 degrees up to 50 degrees on the scale of the antenna tilt. In each position write down the indication of the power output meter. Then return the rotatable part of the stand to zero tilt position, and measure the back-wards-down tilt corresponding to the measurement of the downwards tilt of an airborne antenna. Tilt the antenna in steps of 2.5 degrees up to 20 degrees of the scale. In each position write down the indication of the power output meter.

16) From the results of this measurement draw on a chart paper the vertical radiation pattern of the antenna. The maximum indication of the power output meter is considered as 100%. Thus if the maximum indication was 2mW, the values measured should be multiplied by 50 in the drawing of the radiation pattern. In this drawing the measured power is ploted on the vertical axis in % ( 1% - 1mm), while the horizontal axis indicates the angles of the antenna tilt ( 1mm is 0,5 degrees).

17) The vertical radiation pattern of the antenna should be covered with a transparent paper on which the standard radiation pattern ( a copy of the pattern presented in Fig.36) is drawn. The axes of both charts should coincide.

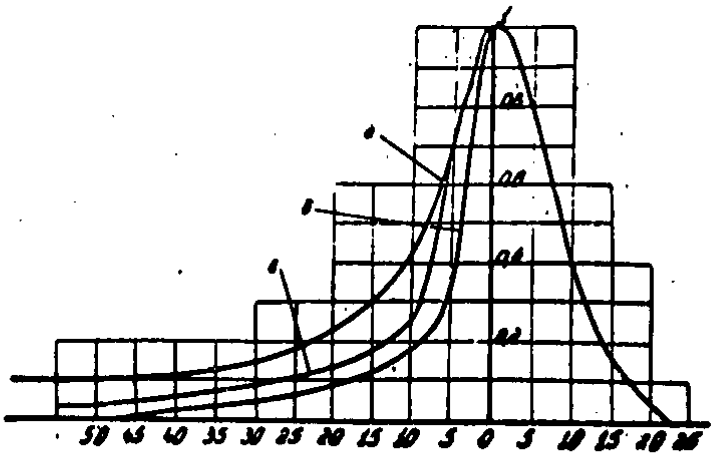

Fig.36

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Fig. 36: - Curves of the standard vertical radiation pattern of the radar bomb sight antenna.

The measured radiation pattern should fall inside the surface between the "a" and "b" curves of the standard pattern from Fig.36. The irregularities of the radiation pattern should be checked by displacing the standard pattern upwards so that the lower limit of the pattern measured coicides with the curve "b" on the standard pattern. The upper limit of the curve in the measured pattern should not surpass the limits of the "b" curve ( see Fig.37).

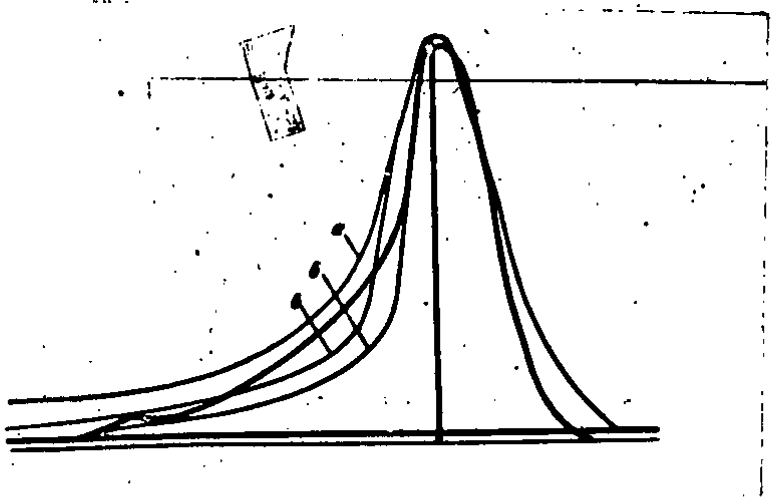

Fig. 37: - Inspection of the irregularities of the measured vertical radiation pattern of the antenna of the radar bomb sight. The thick line indicates the measured pattern, while the thin lines are the limit of the standard pattern.

18) Adjust the antenna of the radar bomb sight by turning the rotatable part of the stand to the zero angle of the antenna tilt. Loosen the gears of the azimuth differentiating mechanism and the electro-mechanism MPR-2 from the coupling on the main gear of the antenna rotation system.

19) Check the direction of the radiation maximum of the antenna in horizontal plane ( the maximum should aim towards the horn antenna, and the power output meter should indicate a maximum in this position). Check the zero adjustment of the power output meter.

20) Turn the control knobs of the attenuators of the 31 IM or 34IM to bring the pointer of the power output meter to the 2 mW reference on its scale;

21) Measure the horizontal radiation pattern of the antenna by turning the antenna in the horizontal plane to the left and right in steps of 0,5 degrees up to 8 degrees from the zero angle on the azimuth scale, and in each position write down the indication of the power output meter.

22) Draw the curve of the horizontal radiation of the antenna. The standard curve of the radiation pattern is presented in Fig.38.

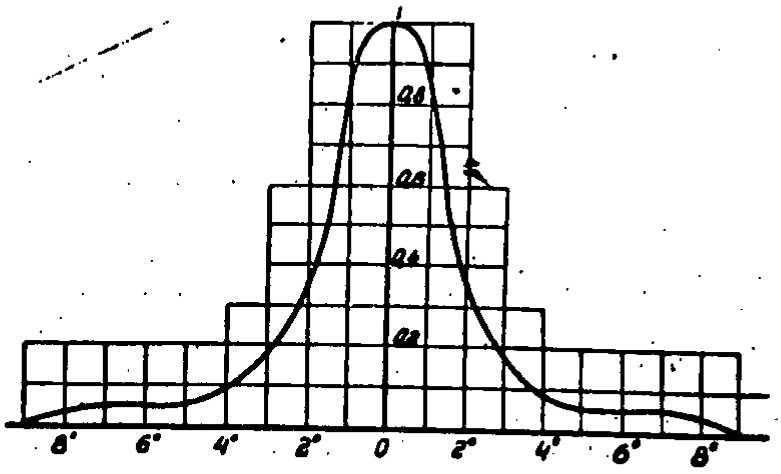


Fig. 38: - Standard curve of the horizontal radiation pattern of the antenna of the radar bomb sight.

The curve of the radiation pattern, obtained with the measurement, should not exceed the limits of the standard pattern curve. The width of the curve at the power level of 0,5 of the maximum value ( half-power points) should not exceed 3.2°.

23) Measure the horizontal radiation pattern of the antenna with an angle of antenna tilt of 45 degrees.

24) Switch off the power supply of the radar bomb sight and of the inspection instrument. Restore the coupling of the gears of the azimuth differentiating mechanism and the electromechanism with the main gear of the antenna assembly.

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B. Inspection of the antenna radiation pattern of the radar bomb sight by means of the field strength meter, type 38 I.

The method of the measurement of the radiation pattern of the antenna by means of the field strenght meter does not substantially differ from that described above. In this measurement the 28 I amplifier should be connected to the 38 I field strength meter, to be used as the indicating instrument. The measurement method is this:

1) Adjust the scales and pointers on the rotatable stand as described in § 30 4, Item 1.
2) Install the field strength meter as shown in Fig.35, and connect the detector holder of the field strength meter by means of a coaxial cable from the 38 I accessory equipment with the "Input" receptacle of the amplifier.
3) Set the switches of the amplifier to the following positions:
   "Mains" to position "Off"
   "Voltmeter" to position "Off"
   "Crystal-Bolometer" to position "Crystal"
   " Input voltage" to position "x 10"
   " Frequency range" to position "400-1,000"
   " Attenuation" to position "1:1"
4) Turn the "Gain" control knob in clockwise direction to its extreme position. The "Continuous tuning" control knob should be set to its medium position. The control knob of the attenuator on the field strength meter should be set to the 30 db reference.
   Connect the power-supply cable of the voltage stabilizer of the amplifier to a 220 V 50 c.p.s. mains and connect the voltage stabilizer to the amplifier.
5) Switch in the power supply of the amplifier by setting the "Mains" switch to position "On". After 1-2 minutes adjust the "Zero adjustment" control to bring the pointer of the voltmeter to zero reference. Set the "Voltmeter" control knob of the amplifier to position "On".
6) Turn on the power-supply of the radar bomb sight and after 5 minutes switch in the high voltage of the transmitter.

7) Find the radiation maximum of the antenna of the radar bomb sight as described in § 30 4, Items 6 and 7. Read the indication on the scale of the amplifier voltmeter. If no voltage is indicated, inspect the performance of the detector in the field strength meter, and if the detecor is found, correct, tune the detector by turning the adjustment screw installed in the back part of the detector cell of the field strength meter. The tuning should be done according to the maximum indication of the voltmeter of the amplifier. If, in the course of the measurement, the maximum of the radiation pattern aims to the horn antenna of the field strength indicator, the attenuation of the field strength meter should not be decreased under 25 db, as the detector would be endangered.

8) Measure the distance from the floor to the medium part of the reflector of the radar bomb sight antenna, and install the horn antenna of the field strength meter at the same height.

9) Correct the direction of the radiation maximum of the radar bomb sight antenna as well as the direction of the horn antenna of the field strength meter to obtain the maximum indication of the meter. If in the course of measurement the pointer of the amplifier voltmeter deflects over the ends of the scale, increase the attenuation of the attenuator in the field strength meter, or turn the "Gain" control knob of the amplifier in anti-clockwise direction to bring the pointer back to the center part of the scale.

10) After the exact maximum of the radiation is adjusted, set the control knob of the attenuator of the field strength meter to the 32, 34 and 36 db references. Use the "Gain" control of the amplifier to bring the pointer of the voltmeter scale to the 50th scale-division.

11) Measure the radiation pattern, as shown in § 30 4, Items 10, 11, 12, 15, 18, 19, 21 and 23.

The reading should be done from the scale of the attenuator of the field strength meter by varying the attenuation in each position so that the pointer of the amplifier voltmeter is always on the 50th scale division.

Subtract from the indications of the attenuator, corresponding to the radiation maximum directed towards the horn antenna of the

field strength meter, the values of the attenuation with various bearings of the antenna.

By means of Table 7 convert the difference obtained from decibels to percent.

Table 7.

| Decimal fractions of decibels / Integral decibel numbers | 0 | 0,2 | 0,4 | 0,6 | 0,8 |
|---|---|---|---|---|---|
| 0 | 100% | 95,5% | 91, % | 87% | 83,2 % |
| 1 | 79,5% | 75,7% | 72,5% | 69,2% | 66% |
| 2 | 63% | 60,2% | 57,5% | 55% | 52,5% |
| 3 | 50,1% | 47,8% | 45,7% | 43,6% | 41,6% |
| 4 | 39,8% | 38% | 36,3% | 34,6% | 33,1% |
| 5 | 31,6% | 30,2% | 28,9% | 27,6% | 26,3% |
| 6 | 25,1% | 24% | 22.9% | 21,9% | 20,9% |
| 7 | 20% | 19.1% | 18.2% | 17.4% | 16.6% |
| 8 | 15.9% | 15,3% | 14.5% | 13,8% | 13,2% |
| 9 | 12,6% | 12,1% | 11,5% | 11% | 10,5% |

Example: The attenuation of the attenuator in the 38 I is 36 db with the radiation maximum directed towards the 38 I horn. With the forwards and downwards antenna tilt by an angle of 5° the attenuation is 34,2 db. The difference is 36 db-34,2 db = 1,8 db. By means of the table we find that this value is equal to 66%.

The reading from the table should be done in the following way: find in the first column the number corresponding to the integral number of the respective decibel value. In the first horizontal line find the number, corresponding to the decimal fraction of the decibel number.

In the place where the respective column and the line cross, find the expression of the decible value in percent.

Example: The difference between the indications on the attenuator scale is 5.8 db. Find in the first column the integral number 5, and in the first horizontal line the fraction 0,8. In the cross of

the horizontal line ( 5th line) and the column marked 0,8, the resulting number is 26,3%. 50X1-HUM

If the decibel value exceeds 10, exclude the tens and convert the rest as explained above. Then divide the result obtained by 10, if the excluded digit was 1, or by 100, if the excluded digit was 2, etc.

Example 1: The difference read from the attenuator scale is 16,2. Exclude the tens, i.e. 16,2 - 10 = 6,2. The result obtained from the table is 24%. Divide the result obtained by 10 and the final result is 2,4%.

Example 2: The difference read from the attenuator scale is 33 db. Exclude the digit 3, and the rest is 3 db. Find the corresponding value in the table, i.e. 50%. Divide the obtained result by 1.000, and the final result is 0,05%.

12) From the results obtained draw the curves of the vertical and horizontal radiation patterns of the antenna and check their forms, as described in § 304, Items 16, 17 and 22.

13) Switch off the power-supply of the radar bomb sight and the 281 amplifier. Couple the gears of the azimuth differentiating mechanism and the electro-mechanism MPR-2 with the main gear of the antenna of the radar bomb sight.

C. Supplementary methods of measurement of the radiation pattern of the radar bomb sight antenna.

1) With the measurement of the radiation pattern by means of the 31 IM or 34 IM instruments the reading may be done from the scale of the attenuators instead of the power output meter scale while maintaining a stable indication of the power output meter. However, with this method the horn antenna must be directly coupled to the waveguide output of the instrument, as the attenuation of the waveguide-to coaxial junction is too high to permit a convenient reading.

The 31 IM or 34 IM instrument with its connected horn antenna should be installed with the measurement at the same height and distance from the radar bomb sight antenna as with the measurement described above under § 304. The conversion should be done by means of Table 7. In this measurement method, the power output meter of the standard signal generator 431 may be used for indication.

2) If a stand is used on which only the antenna without transmitter can be rotated, the measurement may be done by using the radar bomb sight antenna for reception in contradistinction to the above described measurement methods where this antenna was used for transmission. The antenna of the radar bomb sight now receives the signal radiated by the signal generator type 431 or 511. The detector cell from the accessory equipment of the 521 should be connected to the waveguide output of the antenna. The detector cell is coupled by means of a coaxial cable to the 281 amplifier. The antenna of the radar bomb sight and the signal generator are installed at a distance of 8-9 meters from each other, and the waveguide output of the signal generator with the horn antenna should be installed in the horizontal plane intersecting the medium part of the reflector of the radar bomb sight antenna. The signal generator operates with pulses of maximum length ( 100 microsec.).
The klystron of the signal generator should be tuned to 9,370 Mc/s. The measurement of the radiation pattern should be done as described above. The reading should be done from the scales of the attenuators of the signal generator with stable indication of the voltmeter in the 28 I amplifier. The conversion should be done by means of Table 7.

## § 31. Inspection of the hermetical sealing of the transmitter.

Pump the air through the nipple on the transmitter unit to obtain a pressure of 0,4 atm inside the cover. Disconnect the hose of the pump from the nipple and attach a mercury or pointer manometer with a 0,5 atm scale. Do not use the manometer with a 4 atm scale from the accessory equipment of the radar bomb sight. After two hours the pressure inside the transmitter cover may not decrease by more than 0,04 atm., and after 10 hours by 0,2 atm.

## § 32. Inspection of the hermetical sealing of the waveguide system.

1) Connect the pump with the waveguide nipple by means of a hose. Switch in the power supply cable of the pump to a 27V mains. After this a signalling lamp "Heating" should light up to the control panel of the pump.

2) Set the switch on the control panel of the pump to position "On" and measure the time necessary for increasing the pressure inside the waveguide to 1 atm. The time should not exceed 2 minutes. After a pressure of 1,1 atm is ontained, the pump should antomatically stop.

3) Measure the time from the beginning of the operation of the pump to the beginning of the further operation cycle; the time should be at least 15 minutes. The pressure at which the pump is automatically switched on, should be 0,8-0,9 atm. The pumping time should not exceed 1 minute. The measurement of the pressure is done by means of the manometer of the pump.

Supplement No.1

INSPECTION OF TECHNICAL PARAMETERS OF THE RADAR BOMB SIGHT

| Item Nos. | Parameter to be inspected | Measurement result | | | |
|---|---|---|---|---|---|
| 1 | Exterior appearance and the position of the arrangement | | | | |
| 2 | Length of the transmitter pulses and magnetron current with various ranges and types of operation of the equipment with the nominal value of supply volatge | Should be: Range and type of operation | Pulse recurrence frequency (c.p.s) | Length of the pulses ($\mu$ sec) | Magnetron current (ma) |
| | | "Scanning" 8 / 60 | 1,250 | 0,35±0,05 | 6± 8 |
| | | "Scanning" 100, 200 | 577 | 1,0 ± 0,1 | 10 |
| | | "Beacon" | 300 | $2.0^{+0,2}_{-0,1}$ | 9-12 |
| 3 | Average transmitter power with 1 microsec. pulse length, pulse recurrence frequency of 577 c.p.s. and 115V of power supply | at least 36 W | | | |

| | | |
|---|---|---|
| 4 | Rectifier current | Must not exceed the respective values of the magnetron current by more than 5 ma |
| 5 | Peak voltage of the pulse at which the transmitter firing occurs | Not over 90V with the reliable operation of the transmitter. |
| 6 | Discharge in the transmitter at normal atmospheric pressure | If no trigger pulses supplied to the transmitter no discharge may occur. After the inspection, the transmitter performance must be normal |
| 7 | Decrease of pressure inside the transmitter after 10 hours | Not over 0,2 atm |
| 8 | Receiver sensitivity with 1 microsec.pulse and pulse reccurence frequency of 577 c.p.s. | At least 90 db ( related to 1 mW level) |
| 9 | Intermediate frequency of the receiver | Within the limits of 29 and 31 Mc/s |
| 10 | Band pass of the intermediate frequency amplifier, measured at the level of 0.7 of the peak value of the frequency curve | At least 3.8 Mc/s |
| 11 | Maximum detector current measured by the meter of the timer and control unit with tuned detector | Within the limits of 0.4-0,9 ma. |
| 12 | Detector current with the preliminary altitude tuning of the klystron | Within the limits of 75-85 per cent of the maximum detector current. |

| | | |
|---|---|---|
| 13 | Performance of the automatic frequency control circuit | Should safeguard the correct tuning of the receiver with the rotation of the antenna and in all positions of the range switch. Turning of the "Receiver tuning" control by $\pm 25^{\circ}$ must not endanger the performance of the AFC circuit. |
| 14 | Range of suppression of the gain for a short period after the pulse has been transmitted( time gain control). | Must cover a range of at least 15km. |
| 15 | Width of the horizontal radiation pattern at the half-power level with an arbitrary antenna tilt within the limits of $60^{\circ}$ from the fundamental radiation maximum | Not over $3,2^{\circ}$; with the radar bomb sight equipment of the series Nos. 101 and up, not over $3^{\circ}$. |
| 16 | Shape of the measurement horizontal radiation curve | Must fall inside the limits of the standard pattern curve |
| 17 | Shape of the vertical radiation curve | Mustt fall within the tolerance given by the standard pattern curve |
| 18 | Standing ( travelling) wave ratio in the antenna and waveguide assembly at the frequency of the magnetron | At least 70% ( travelling wave ratio) or not over 1,43 ( standing wave ratio) respectively. |
| 19 | Variation of the travelling wave ratio in the course of antenna rotation by $360^{\circ}$ | Not over 5% |

| | | |
|---|---|---|
| 20 | Sector scanned field of vision of the antenna | In arbitrary sectors of 60°, 120°, 180°, 240° and 300°. The width of the 60° sector should be 60° - 85° with fast scanning and 50°- 70° with slow scanning. The front sector should be wider by 10°-15° than the neighbouring sectors. With the operation of the optical bomb sight the front sector width should be at least 60° ( the dark sector is not considered). |
| 21 | Rotation velocity of the antenna with continuous rotation | Must be: a) with fast rotation 19-28 r.p.m. b) with slow rotation 9 - 17 r.p.m. |
| 22 | Scanning rate with sector scanning | Must be: a) with fast scanning 70-120 scans/min b) with slow scanning 50-80 scans/min |
| 23 | Position of the center of the front sector with the operation of the optical bomb sight with fast scanning | May differ from the position of the longitudinal marker by ± 5° |
| 24 | Antenna tilt angles in reference to the horizontal direction of the fundamental radiation maximum | Upwards at least 5°, downwards at least 20° |
| 25 | Accurancy of the reading of the antenna tilt angles on the indicator of the timer and control unit | Better than ± 2° |

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| | | |
|---|---|---|
| 26 | Rate of change of the antenna tilt angle | Within the limits of 4-6 degrees per sec. |
| 27 | Range of sweep of the plan position indicator tubes | Must be: a) from 8 ± 1 km to 60 ± 5km with continuous change of range from 10 to 60km<br>b) 100 km<br>c) 200 km ± 10 km |
| 28 | Change of the sweep amplitude on the plan position indicator with switching the sweep ratio | Must not exceed 8 mm ( an irregularity of the sweep length with the rotation of the antenna of up to400m on the 8 km sweep ratio is admissible). |
| 29 | Variation in the brightness of the calibration markers and the course marker | Possibility of regulation from minimum to maximum brightness |
| 30 | Distortion of the calibration circles with the rotation of the antennd in the 10 km sweep ratio | Not over 10 per cent |
| 31 | Frequency division in the crystal controlled mixer of the range unit at 75kc/s ± 0,01% | Must be: 1:1, 1:2, 1:5, 1:6, 1:13, 1:25 ( with a tolerance of 1:24 and 1:26). |
| 32 | Peak voltage of the pulse firing the transmitter, produced in the range unit | Must be at least 105V at all pulse reccurence frequencies |
| 33 | Performance of the system of step-delay of the beginning of the sweep in the "Beacon" type of operation | Reliable performance must be obtained up to a range of 300 km in steps of 20 km |

| | | |
|---|---|---|
| 34 | Performance of the system of continuous delay of the beginning of the sweep in the "Range" type of operation | ... delay of the beginning of the sweep in reference to the transmitter pulse must be reliably obtained within the limits from -15 km to +40 km |
| 35 | Measurement range of the computing mechanism | Must be within the limits from 1 km to 30 km |
| 36 | Accuracy of the range measurement by means of the computing mechanism | Must be: a) From 2 km to 14 km... better than ± 100<br>b) from 16 to 28 km..... better than ± 200 km |
| 37 | Constant error in the range measurement caused by the delay of the pulse in the transmitter and receiver channels | Not over 250 m |
| 38 | Accuracy of coincidence of the plan position indicator sweep with the antenna rotation | Must not exceed:<br>a) maximum individual error ± 4°<br>b) mean quadratic error 1,5°<br>The curvature of the sweep trace from the center to the circumference of the screen must not exceed 3° |
| 39 | Width of the angle covered by the course line | Not over 1,5° |
| 40 | Accuracy of the position of the course marker in reference to the circular scale of the tube in the "Selsyn zero" type of operation | Equal to or better than ± 1° |
| 41 | Accuracy of the position of the display on the plan position indicator screen in reference to the north(0° of the azimuth scale)in the"Compass" type of operation | With the sweep ratio of 100 km:<br>a) maximum individual error not over 4°<br>b) mean quadratic error not over 2° |

| | | |
|---|---|---|
| 42 | Rate of change of the angle of deflection of the selsyn transmitter PDK-45 in the azimuth stabilization system | Must be at least 4.5° per second |
| 43 | Variation of the brightness of the spot on the screens | Should vary from zero to maximum |
| 44 | Focusing of the spot on the indicator tubes | The focusing must not take place in extreme positions of the "Focusing" potentiometer control |
| 45 | Adjustment of the position of the beginning of the sweep on the indicator tubes with the turning of the "Centering" potentiometers | The possibility of adjustment of the beginning of the sweep to the cross-mark of the filter of the PPI must be safeguarded, and the beginning of the PPI sweep must be adjustable by at least 5 mm. The beginning of the monitoring tube sweep must be adjustable by at least 10 mm |
| 46 | Accuracy of the transmission of the angle of deflection of the optical bomb sight, in reference to the course stabilizer, to the stator of the selsyn transformer | Must be better than 0,5° with drift angles up to ± 20° and better than 1° with drift angles up to ± 30° |
| 47 | Accuracy of the compensation of the bank angles in the transverse stabilization channel | Must be:<br>a) with the bank angles of ± 10° equal to 1°, or better<br>b) with bank angles over ± 10° equal to 3°, or better |
| 48 | Accuracy of the performance of the slant range synchronization channel with angles of sight up to 60° | Must be:<br>a) up to altitudes of 4,000m equal to ± 80 m, or better,<br>b) at altitudes over 4,000m equal to 2% of the altitude, or better |

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| 49 | Position of the transverse marker with maximum expansion of the sweep | Must be in the center of the operational part of the sweep within the limits of 1 km. |
| 50 | Rate of change of the compensation of the angle of deflection of the optical bomb sight in the coupling unit of the optical bomb sight | Must be equal to 4,5° per second, or better |
| 51 | Position of the longitudinal marker | Must direct towards the zero reference of the azimuth scale with an accuracy of ± 1° |
| 52 | Values of the voltage produced by the power-supply unit | Stabilized:<br>+240V ± 10 per cent ( adjustable)<br>+300V ± 10 per cent<br>+105V ± 10 per cent<br>-150V ± 5 per cent<br>-255V ± 10 per cent<br>Not stabilized:<br>+255V ± 5 per cent( up to series No 57)<br>+265V ± 5 per cent<br>+4,000V ± 25 per cent<br>+1,000V ± 30 per cent |
| 53 | Performance of the equipment with variations of power supply voltage of 27V ± 10% and 115V ± 3% | Standard performance of the operation must be safeguarded, and the following Items of the Technical regulations must be respected: 22, 28, 32, 34, 37 and 49. |
| 54 | Performance of the pump and the sealing of the antenna and waveguide assembly | The regulations given in Chapter IV, § 32 must be respected |
| 55 | Performance of the heating system | The system must automatically cut in with the temperatures not under -5°C and cut off at temperatures not over +40°C. |

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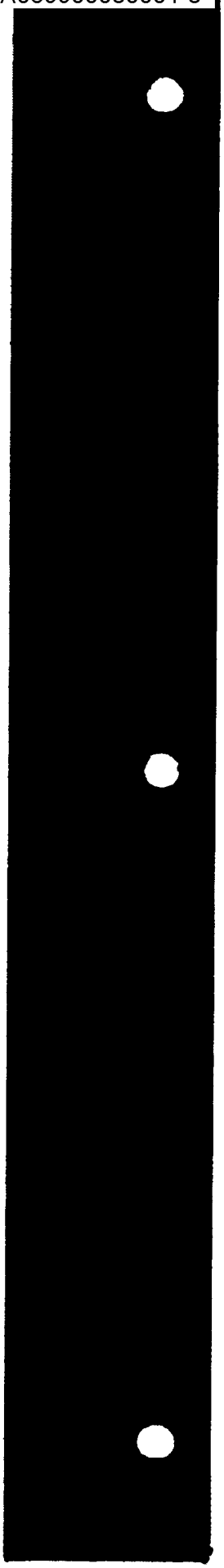

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